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THE FUTURE OF THE BRITISH CHEMICAL INDUSTRIES.

THE address delivered by Prof. Stanley Kipping, F.R.S., to the members of the Chemical Section of the British Association, was devoted to the consideration of "whether any steps can be taken to place the chemical industries of the United Kingdom of Great Britain and Ireland in a more prominent position than that which they now occupy in the world of commerce." The *motif* of the address is that the speedy disappearance of British chemical industries can be averted only by the close co-operation of the manufacturer and the scientist.

This is a theme which has been dealt with repeatedly by various speakers and writers, but perhaps never more suggestively than in the present address, and is of such importance that, until some change comes over the present aspect of affairs, it cannot be too often insisted on. The precarious state of our chemical industries is only too obvious; not only have we completely lost the manufacture of dyes, but, as may be learnt from a study of the technical journals and the Board of Trade returns of recent years, "in the manufacture of 'fine chemicals,' including perfumes, celluloids, and crude coal-tar products . . . . the decadence of our industry is far advanced; in the case of the heavy chemicals our position, perhaps, is not quite so serious at the present moment, but the future is dark and threatening." Even in regard to the new Patents Act, which came into force last month, and has been hailed by many as inaugurating a new era, Prof. Kipping is far from consoling. Although it "will prove to be of great value in many respects, it will do little to foster British chemical trade, and the development of British chemistry. Our chemical industries will continue to decline, possibly more rapidly than heretofore."

It is the combination of the research chemist with the manufacturer which has led to such remarkable results in the case of the German chemical industries, and it is only by following a similar system that we can hope to avert disaster. Our failure in this direction in the past has been ascribed, on the one hand, to a lack of properly trained chemists, resulting from the unsatisfactory condition of secondary education, or from the nature of the teaching in our universities and technical schools, and, on the other, to the insufficiency of the time and money devoted to research in manufacturing industries, and the absence of co-operation between the manufacturer and the scientist.

These are grave matters, affecting the welfare not only of the purely chemical industries, but also of all manufacturing processes in which arise problems requiring the aid of the chemist for their solution. It may well be asked what manufacturing industry does not fall within the scope of this definition.

No doubt the improvement of secondary education might make the training of the chemist an easier and shorter

process, but as it is, much may be done. To be of real use the chemist must be no mere routine analyst, no product of so-called technical instruction; he must be an investigator, capable of putting his knowledge at the service of the manufacturer and of applying his mind to the solution of the problems arising in the course of the industry. Prof. Kipping pleads for a longer and more thorough training. An Honours B.Sc. degree should not be given without research, and a student who has no experience as an investigator should not be recommended by his teacher for any post in which more than routine analysis is required. The Pass B.Sc. degree should be merely an indication of a general education in science. We might go further with advantage, and refuse to give any degree in science to those who have no experience in research. No amount of book knowledge, no amount of practice in laboratory manipulation, will make a chemist; he must acquire what we may term the research point of view. To this end it is highly advisable that the student should have assistance to guide his first steps, but he is no chemist who cannot walk alone. A much higher class of trained chemist would be turned out were we to insist on at least some experience in joint research before the Pass degree, and to keep our Honours degree strictly for those who show capacity for the planning and carrying-out of an investigation on their own initiative and responsibility. Prof. Kipping suggested that the training of the works chemist should last five years, the first three being spent on the usual routine work on which a Pass degree is now granted, and the remaining two devoted to research and to specialisation in some branch of chemistry. Our suggestion might demand an even longer course of training, but this is justified by the remark of a later speaker in the Section, who held that not five but ten years must go to the making of a chemist, a remark greeted by those present with some smiles, but general approval. The professor expressed himself as entirely out of sympathy—and here, we believe, the great majority of teachers of chemistry will agree with him—with the attempt to train works chemists by means of a two or, at most, three years course of instruction in science followed by one year's work with the plant necessary for carrying out some technical process on a miniature manufacturing scale. Such training "can only result in the production of a sort of combined analytical machine and foreman." It would be better for the chemical department of a technical school to devote itself to the investigation of technical problems, given the co-operation of the manufacturers and a sufficient supply of students.

So much for what may be done on the academic side; what of the manufacturers? Unfortunately, the British manufacturer has little conception of what assistance may be expected from the scientist. Either as a "practical" man he sneers at those he terms "theorists," or, rushing to the other extreme, he expects miracles in the solution of intricate problems without delay. In many cases he is unwilling even to put his own knowledge at the disposal of the scientist. In most cases, his main anxiety appears to be to get the work done on the cheap. In these matters, great improvements are possible. As to what assistance he may expect from a works chemist, the manufacturer might well inquire of the nearest teacher who is also an active investigator. If the engagement of a permanent chemist is not desired, Prof. Kipping suggests the founding of a temporary research scholarship at some university. Such a scholarship might be arranged to the benefit of the manufacturer, of the scholar, and of the university. In any case, the investigator must be given every opportunity of studying the process and plant in the works, and the manufacturer must not expect to get problems, affecting an extensive industry with large capital, solved for the price of a bronze medal or even the offer of a reward of £20.

At present a thin stream of research in chemistry trickles through our journals. Most of the work is concerned with subjects of purely scientific interest; without in any way decrying such work, much of the time and labour expended might well be turned to the study of technical problems. Here, again, the manufacturer must come to the assistance of the scientist by supplying the initiative. Moreover, once the manufacturer, by employing research chemists, opens up the prospect for trained investigators, the numbers of students will increase, and the trickle of research swell to the mighty volume of a Tweed in flood.

We have dealt with the more important points in the address, space not permitting us even to sketch the many weighty arguments advanced by Prof. Kipping in support of his contention that only in the co-operation of science and technical skill lies the salvation of our chemical industries. We hardly need again point out the important and constantly increasing share of electrical processes in these industries, which will not improbably result in advancing electro-chemistry to a leading position in the electrical field and creating new demands for electrical enterprise.

Unnatural Evolution.

In the address of Prof. W. Ridgeway, President of the Anthropological Section of the British Association, the author took as his most important topic natural laws in relation to our social legislation, and pointed out that despite the abundant examples which surround us on every hand, of the irresistible and unerring course of Nature in preserving the fittest and evolving higher forms of life, no statesman ever dreamed of taking her great principles into consideration when devising any scheme of education or social reform. It is assumed that all men are born with equal capacities, no matter what their origin, and that all that is necessary to make the children of the working classes equal to those of middle-class parents is similar environment. But this view fails to take account of the influence of heredity, which is so great that, in the opinion of Prof. Ridgeway, while the middle classes are continually being reinforced by the best of the working classes, their existence is really due to a long process of natural selection and the survival of the fittest. While it is essential that the State should provide educational facilities to enable exceptionally gifted children of humble origin to rise even to the highest positions in the community, it is useless to provide such a ladder for the mass of children, the vast majority of whom can never climb beyond its lowest rung.

In order to produce a stalwart brood of citizens, the legislator ought to conform to the principles of the stockbreeder, fostering the increase of the best elements in the State, and discouraging the multiplication of the worst. Yet our statesmen of all parties have adopted precisely the opposite policy. Education is provided at the cost of the State, the offspring of the wastrels in particular are given free meals, and we even hear demands that the State shall clothe and rear children—at the cost of the middle-class ratepayers and taxpayers, who also have to feed, clothe and educate their own children at their own expense. The heavy burdens already laid upon the middle classes materially retard their rate of increase, by rendering marriage more difficult, and thus the present policy tends to reduce that class of citizens which, standing between the excessively wealthy and the very poor, has in all ages been recognised as the mainstay of every State. As the author remarks, the inevitable result of persistence in the present line of policy will be the moral and physical deterioration of the British nation—the natural consequence of "refusing to apply to the human race the laws which inexorably regulate all Nature."

SWITCH AND TRANSFORMER OIL.—I.

By "GLUCKAUF."

The increasing use of oil-insulated transformers and oil switchgear calls for a more careful study of the insulating oil question than has up to the present been given to it—at any rate, as far as the average engineer is concerned. It is only necessary to look around the various high-tension stations and see transformers being worked with the oil exposed to dust, dirt and moisture, to be convinced that sufficient attention is not paid to the careful handling of the insulating oil; especially so in view of the fact that a very small percentage of moisture will reduce the dielectric strength of transformer oil to 50 per cent. of the value the oil had when quite free from moisture. Dust on the oil surface is carried down into the winding spaces by convection currents, where it is very liable to seriously reduce the insulation strength and start a discharge. It is now universally admitted that the oil-break switch is better than the air-break, owing to the fact that with the oil switch the actual break occurs when the current wave is passing through its zero value, so that no dangerous oscillations are set up, while for underground mining work all switchgear and resistances should be oil-immersed to avoid danger from explosions of fire-damp. As regards transformers (except in the smaller sizes) the oil-cooled is considerably cheaper than the air-cooled, while above 5,000 volts it is almost impossible to build air-cooled transformers. Hence the question as to the insulating oil best suited for the purpose is of considerable importance. Animal and vegetable oils are quite inadmissible, owing to their liability to turn acid and become viscous and gummy with age. Further, they are liable to congeal in cold weather to a practically solid mass. Resin oil was at one time much used, especially for transformer work, but it is almost impossible to obtain resin oil of constant composition, partly owing to the comparatively small quantities in which it is distilled, and, further, because the resin employed for its manufacture also varies considerably. Resin oil is also very liable to congeal, to turn acid and also to gum; and at the moment the price of pure resin oil is higher than that of the corresponding mineral oil.

Swinton gives the dielectric strength of resin oil as being from 4 to 10 times that of air, a voltage which sparks across 2·54 mm. in resin oil, sparking across 25·4 mm. in air; while a voltage sparking across 50·8 mm. in resin oil was found to spark across 200 mm. in air.

Compound oils consisting of mixtures of resin oil and mineral oil have also been used, but found unsatisfactory, as the resin oil tends to separate out and form a thick mass at the bottom of the oil tank.

A pure mineral oil is now universally used, both for transformer and for switch work, such oils being practically free from liability to form carbonaceous deposits, except when breakdown occurs, when pure carbon is deposited and hydrogen evolved. The oil should comply with the following specification:—

1. The oil must be a pure mineral oil, obtained by fractional distillation from heavy petroleum product, and not subjected to any chemical treatment whatever. It should be absolutely free from moisture, alkali, acid or sulphur compounds.

2. The flash point, as determined by an approved type of "closed test" apparatus (Pensky-Marten or Gray's apparatus) should not be less than 175° C. (347° F.), while the burning test should be at least 200° C. (392° F.).

3. The dielectric strength, as measured by the voltage required to arc across two pointed electrodes 4 mm. apart, submerged to a depth of 6 to 8 centimetres, should have a minimum value of 30,000 volts.

4. The *specific* viscosity, as determined by the Engler or other viscometer, should not exceed 10 to 15 at a temperature of 20° C., water being taken as the standard. Further, the oil should still be sufficiently liquid at 0° C. to readily form drops.

5. The specific weight at a temperature of 15° C. should have a minimum value of 0·87 and a maximum value of 0·92.

6. When heated to 100° C. under standard conditions as regards shape and capacity of vessel used, &c., for eight hours, the loss by evaporation should not exceed 2 to 3 per cent.

An oil that complies with the above conditions should prove a reliable insulator, provided due care is taken as regard storage and use. The requirements as regards switch oil are very similar to those of transformer oil; a fairly viscous oil appears to be advisable as being less readily punctured by the arc; at the same time too heavy an oil must not be used, or it will prevent the switch blades making good contact, and therefore cause heating. It should also not be affected by the lowest temperature to which the switch may be exposed.

Impurities.—Chemical treatment of any kind must be strictly excluded, as the slightest trace of acid or alkali will sooner or later seriously attack the windings, electrolytic action hastening the process. Newly wound generators and transformers always show a strong electrolytic action due to minute traces of acid and moisture in the cotton covering, cotton being always spun in a moist condition, and more or less "treated" with various substances liable to develop fatty acids on exposure to the moist air. In the present state of the cotton market, it appears to be impossible to avoid this "treatment" of the raw cotton, and it is, therefore, advisable to take great care to exclude as far as possible all chance of moisture being taken up by the cotton covering during winding operations, &c. Alkali compounds, especially caustic and chloride products, are equally objectionable, being readily subject to electrolytic action. For these reasons, a dark coloured oil should not be objected to, as light oils may owe their colour to chemical treatment. All oils appear to darken gradually with use, but this change of colour does not seriously affect their properties as insulators, the change being due to heating.

Sulphur compounds have a very bad effect, a small percentage lowering the dielectric strength to quite an alarming extent, in addition to which sulphur readily attacks copper, so that all traces of sulphur must be removed.

Flashing Point.—The flash point must be high, because although under working conditions the temperature rise of any transformer should not exceed 50 to 55° C., in the event of part of the winding becoming faulty, the oil may be suddenly heated up to quite a high value before the switchgear cuts the faulty transformer out. Quite a small percentage (approximately 0·5) of light oil, such as benzine, will lower the flash point by something like 100°, so that the "closed test" apparatus, which does not allow any vapour to escape, is more reliable than the "open test" apparatus, in which the lighter oils would escape long before the temperature of 175° C. was reached.

An oil having the following tests No. 1, when mixed with 5 per cent. of benzine gave results as No. 2, and when mixed with 1 per cent. benzine gave results as No. 3:—

	Test. 1.	*Test* 2.	*Test* 3.
Closed flash point ...	385° F.	82° F.	102° F.
Open flash point... ...	386° F.	90° F.	111° F.
Fire test	412° F.	101° F.	120° F.

If open test apparatus is used the flash temperature should be raised to 185° C. Variation in the size and depth of the oil cup used to heat the oil and in the rate of heating will vary the resulting value obtained for the flash point, so that it is necessary to use a standard form of testing apparatus.

Gray's apparatus is generally used in this country, and is very satisfactory; on the Continent the Pensky-Marten tester is generally used. The size of the oil cup used in the Gray apparatus is the same as that used in the Government Standard Petroleum Tester as designed by Abel—viz., 2 in. in diameter and 2·20 in. in depth. The oil cup in the Pensky-Marten apparatus is practically of the same size, so that the readings given by the two forms of tester agree one with the other.

Dielectric Strength.—Variations in the shape of the electrodes, depths under oil, &c., will change the value obtained for the dielectric strength. Pointed electrodes are apt to give such variable results as to be unreliable; on the whole ball and ball electrodes about 20 mm. in diameter appear to be the most satisfactory if kept accurately in line—*i.e.*, not askew.

The variation of sparking distance with variously shaped electrodes is a subject that up to the present has not been

fully investigated; this, no doubt, accounts for the variations in the values given by the different investigators for the dielectric strength of air. Dielectric strength is the power of an insulator to withstand the electrical stresses due to a given voltage, and must not be confused with ohmic insulation resistance, which determines the leakage through the insulation. Air has a very high specific resistance, but has not much dielectric strength, hence a high voltage readily arcs across an air-gap. Glass has a high dielectric strength, 0·3 mm. resisting 22,000 to 25,000 volts, but its specific resistance is not nearly so high as that of air. Taking the disruptive strength of air at a thickness of 0·05 mm. as being 1,670 volts (maximum per mm.), Steinmetz obtained for oil a maximum disruptive strength equal to five times that of air. Table I gives the striking distance, or disruptive strength, of air as obtained by Siemens and Steinmetz,

TABLE I.—Dielectric Strength of Air.

	Alternating.	*Continuous.*
Effective voltage.	Striking distance.	Striking distance.
2,000	0·4 mm.	0·25 mm.
4,000	1·26 „	0·75 „
6,000	2·66 „	1·45 „
8,000	4·08 „	2·33 „
10,000	5·78 „	3·33 „
12,000	7·60 „	4·44 „
14,000	9·88 „	5·67 „
16,000	11·73 „	7·00 „
18,000	13·20 „	8·30 „
20,000	14·76 „	9·60 „
25,000	22·0 „	— „

using a point and plane as electrodes, the alternating voltages being R.M.S., or effective values. The American Institute tests using sharp pointed electrodes and sine wave currents gave 5·7 mm. for 5,000 volts, and 25·4 mm. for 20,000 volts.

As already stated, pointed electrodes appear to give variable results. Whatever form of testing apparatus is used, the oil should always be filled up to the same level, so that the sparking balls are submerged to a fixed depth each time. The apparatus must be kept perfectly dry and clean; the balls should not be touched with the bare hand, or perspiration may find its way into the sample of oil, and, of course, spoil the test.

Moisture and dust must be most carefully excluded, hence it is advisable not to open the sample until it is actually required for testing purposes, so as to keep the sample perfectly free from moisture. The balls should be kept clean and well polished during the tests.

As regards testing for moisture, it is almost impossible to ascertain the amount of water present, owing to the fact that when one heats the oil to ascertain this figure there is at the same time sure to be a loss by evaporation of the oil itself.

If a little anhydrous copper sulphate be placed in a test tube with the oil and well shaken up, a bluish tinge in the sulphate will give some indication that moisture is present. The operator should avoid breathing on the testing apparatus, as obviously an excessive amount of moisture may be thereby introduced. Either the spark-gap should be kept constant and the voltage varied, or the voltage kept constant and the gap varied; only one of these methods should be employed, in order that all tests may be made under the same conditions. Oil is not so good an insulator for low as for high frequencies, but for commercial periodicities, say, between 25 and 100 cycles, the variation is negligible. It is very desirable to use a sine wave E.M.F. for testing, hence the voltage should be varied by altering the strength of the generator field and not by the use of a resistance.

It is a curious fact that after the first one or two discharges the dielectric strength of the oil increases.

This increase in the dielectric strength may be due to the arc having a drying effect on the oil, or possibly to the impurities being burnt out. At each discharge a bubble of hydrogen gas is formed and a small amount of carbon thrown down; after a time the amount of carbon deposit is sufficient to blacken the whole of the oil, and the dielectric strength is rapidly reduced as the amount of carbon deposit increases; hence the necessity for renewal of the oil in oil switches from time to time, a point frequently neglected. The testing balls or electrodes rapidly become dirty, and it is essential that they should be easily and quickly removable so as to be readily accessible for cleaning purposes. This should not disturb the adjustment of the spark gap. A capacity of two to three-tenths of a litre will be found suitable for the testing apparatus. A fine fuse in the circuit should limit the current to, say, 10 KW., so as to reduce the work of keeping the terminals clean. Bubbles of air in the oil must be got rid of, as they will lower the dielectric value; a gentle heating will readily remove all traces of air bubbles.

It is important to measure carefully the exact temperature of the oil during the test, as rise of temperature rapidly lowers the insulation resistance, and also affects the dielectric strength to some extent.

Specific Viscosity.—The viscosity does not affect the insulation resistance, many of the lighter oils such as kerosene and turpentine having as high or even a higher insulation resistance than the heavy oils. Hence for transformer work, considerable variation in the viscosity is permissible, although a very great increase in viscosity should not be allowed, since the rapid circulation, and hence the cooling, of the oil will be thereby affected.

On the other hand, in the case of switch oil, viscosity is of importance, as a light oil is more easily displaced by the arc than a heavy one.

In England there is no very definite standard for viscosity. With the Redwood viscometer, refined rape oil is usually adopted as the standard, 50 cc. of refined rape oil taking 535 seconds to flow through the standard-sized orifice, 0·067 in. in diameter, at a temperature of 60° F. (16° C. approx.). But as the refined rape oil has a tendency to become more viscous on keeping, it is preferable simply to take the number of seconds occupied by the 50 cc. to flow as being the figure representative of viscosity on this instrument. Sperm oil is not now taken as a standard.

Water would appear to be much more accurate as a standard, and this is the standard adopted by Engler and by Saybolt.

The only possible objection to the use of water is that a comparatively small-sized orifice must be used owing to its rapid flow, so that, with heavy oils, the time taken for a given quantity to pass through the orifice is unduly long. With very heavy oils used for lubricating purposes, this objection may have some grounds, but it can hardly be of moment in the case of insulating oils.

The Boverton Redwood viscometer is generally used in England, the viscosity of the oil being taken from the time required for 50 cc. to flow through, as compared with the time taken for 50 cc. of the standard oil to pass through the instrument. Means are provided for regulating the temperature, and, of course, measuring the same, which details need not be described here. The standard orifice consists of a hole 0·067 in. in diameter drilled in an agate jet piece, the upper end being dished and closed by a small brass ball valve. The Saybolt viscometer used in America is on a similar principle to the Redwood instrument, the oil being run into a graduated receiver. Engler's viscometer is the standard instrument adopted in Germany, water being always taken as the unit or standard.

At 20° C. (68° F.) 240 cc. of water take 54 sec. (this figure varies slightly with each instrument) to flow through the Engler viscometer; hence, by dividing the time taken by a given oil (240 cc.) to flow through (at the same temperature) by the figure 54, one obtains the specific viscosity of the oil. Thus, if 240 cc. of oil take 400 sec. to pass through the instrument, the specific viscosity at that particular temperature is $400 \div 54 = 7{\cdot}40$.

Specific Gravity or Specific Weight is not proportional to viscosity, although, as a rule, an oil that has a high specific gravity will also have a high viscosity. For general purposes the hydrometer will give sufficiently accurate results, although as regards scientific accuracy, the gravity bottle or the hydrostatic balance gives, of course, more reliable values.

An imperial gallon of pure water (specific gravity 1·00) weighs 10 lb. (at 60° F.), and has a volume of 0·1605 cb. ft., hence the weight of a gallon of oil at 60° F. is readily determined from its specific gravity at that temperature.

Thus a gallon of oil having a specific gravity of 0·90 (at 60° F. = approximately 16° C.) will weigh 9 lb. The U.S.A. gallon equals 0·8325 of an imperial gallon.

Volatility.—This is readily determined by heating, say, 5 grammes in a large porcelain basin to a temperature of 100° C. for eight hours, and finding the loss in weight, from which the percentage loss is readily determined. The sample of oil should be thoroughly dry, otherwise moisture driven off will affect the result obtained.

Providing the flash point is not lower than 175° C. there will be no serious evaporation loss of oil under ordinary transformer working conditions. The use of vaporimeters, such as Archbutt's, is not necessary for determining the evaporation losses of transformer oil, as the electrical working conditions are not so severe in this respect as those to which, say, engine cylinder oils are exposed. At the same time, it should be noted that the result obtained varies greatly with the manipulation of the test, capacity and shape of vessel used, &c.

Messrs. Alexander Duckham & Co., Ltd., who make a speciality of the manufacture of transformer oils, adopt the following standard :—A glass beaker 4 in. high, 4¼ in. in internal diameter is carefully desiccated and weighed. In it is then placed about 2 gm. of the oil to be tested, and the weight is again carefully taken. The beaker is then placed in a hot-air oven kept at a temperature of 100° C. for eight hours, the thermometer bulb being ¼ in. from the floor on which the beaker stands. The beaker is finally allowed to cool in a desiccator and reweighed. One of the best known transformer oils on the market—*i.e.*, transil oil—under these circumstances loses nearly 4 per cent., but Messrs. Alex. Duckham & Co. consider that the figure should not exceed 2 per cent.

Oxidation.—The affinity for oxygen so marked in the case of vegetable, resin, and animal oils, producing sticky, gummy deposits and developing fatty acids, is almost entirely absent in the better grades of mineral oils. Hence there is absolutely no danger to fear from spontaneous combustion with mineral insulating oil. This spontaneous combustion scare was raised some years ago in connection with the use of oil-transformers in mines, evidently under a misunderstanding as regards the class of insulating oil used for electrical work.

True ! cases have occurred (very few and far between) in connection with oil switches where the oil has fired, but this has been traceable to gross neglect to periodically change and filter the insulating oil, so as to remove the carbon deposit.

METERING AND ITS ATTENDANT LOSSES.

By JACQUES.

In a previous paper entitled "Rates and Systems of Charging," the writer attempted to discuss the question of the metering of electricity from the point of view that the convenience of the consumer was of primary importance to the central station. The present article proposes to discuss another phase of the question from the standpoint of the station only, and will deal with those losses which are inseparable from any system of measurement by meter that may be adopted by the undertaking.

For the purposes of this argument, all meters may be divided into two large classes, viz., watt-hour and ampere-hour meters, each of which class has a "fault" peculiar to itself. On the one hand, there is the loss incurred in the shunt circuits of the watt-hour meters, and on the other hand, there is the loss due to the fact that ampere-hour meters take no note of varying voltage, whereas most authorities supply, or endeavour to supply, at a little *above* the declared pressure.

The losses due to inaccurate calibration may, in practice, be ignored, for on the average being taken, it would be found that they would cancel out, because as many meters would be fast as would be slow ; and as this kind of loss is common to both classes of meter, it falls outside the scope of this paper.

The case of watt-hour meter shunt losses may be first examined, and, in passing, it is of interest to point out that a far larger proportion of "lost units" is accounted for at the switchboard, in all the indicating instruments, than is usually imagined—in fact, the result of a calculation of these unpaid-for watt-hours will probably be somewhat of a surprise to most engineers.

For the sake of example, throughout this article a small undertaking supplying, say, 2,000 consumers at 200 volts,

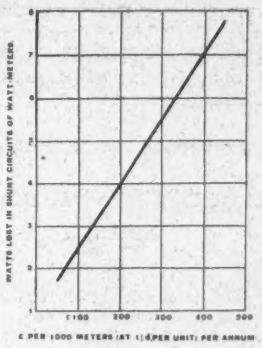


Fig. 1.

will be considered as the basis for calculation. At least one meter will be installed on the premises of each of these consumers, so that 2,000 meters are to be dealt with.

If these be watt-hour meters, the shunt losses must be calculated at the price which it costs the station to generate its units and *not* at the selling price, as under no circumstances, not even if the use of watt-hour meters were discontinued, would these units be paid for by any consumer.

Taking 1½d. as a fair average works cost per unit for a station of this size, and allowing 5 watts for each shunt circuit, we get as the total monetary loss for the 2,000 meters for a year of 8,760 hours :—

$$1\tfrac{1}{2} \times \frac{2{,}000 \times 5 \times 8{,}760}{1{,}000 \times 240} = £547\ 10s.,$$

which result is also shown on curve No. 1.

Taking now the case of ampere-hour meters, it may be assumed that the average size of meter installed is for 10 amperes, and experience shows that the average power used per meter expressed as a continuous load is about $\frac{1}{12}$ full load, this figure being, if anything, low rather than high, so that for the 2,000 ampere-hour meters at 200 v., we get the following units registered in the year :—

$$\tfrac{1}{12} \times \frac{8{,}760 \times 10 \times 200}{1{,}000} \times 2{,}000 = 2{,}920{,}000 \text{ B.T.U.}$$

If now, the average voltage has been only 2 per cent. high, we find that a number of units equal to $\frac{1}{50}$ of the above figure, *i.e.*, 584,000 B.T.U. has been altogether missed by the ampere-hour meters, assuming that they are correctly

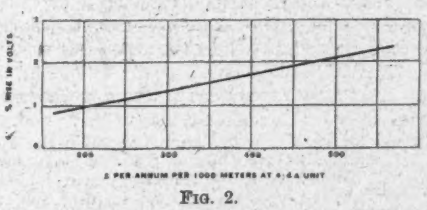


Fig. 2.

calibrated for the 200 v., and mark this: these lost units have been supplied to the consumers, and must be reckoned at selling price, as, had watt-hours been used, the units would have been measured, and, presumably, paid for.

The loss, therefore, due to ampere-hour meters may be calculated at 4½d. per unit as a fair average selling price for such an undertaking, and is thus £1,095, or exactly double that due to watt-hour meters.

The conclusion seems to be obvious ; but that we may not run away with an idea drawn only from imaginary data, however fair such assumed figures may be, the following figures for a large London undertaking may be taken :—

The total amount received for energy, exclusive of meter rents and public lighting, for a year, was £222,076·6.

If ampere-hour meters are used, and we allow 2 per cent. for high volts, as in our imaginary case above, we find that the loss was £4,441, approximately.

If now watt-hour meters had been used, and 5 watts per meter allowed as before, we find that as there are roughly 11,000 meters, and the works costs are 1·05d., the loss would have been—

$$\frac{1{\cdot}05 \times 11{,}000 \times 8{,}760 \times 5}{1{,}000 \times 240} = £2{,}107{\cdot}8,$$

which result confirms our previous hypothetical case.

Fig. 2 shows the curve for ampere-hour losses, using the figures of our assumed example.

THE FREUND SELF-WINDING TRACK BRAKE.

We recently received from Mr. Edwin Freund particulars of an extremely ingenious mechanical track brake applied by a spiral spring, on entirely novel lines. One of these equipments has been fitted on a car belonging to the Yorkshire (W.D.) Tramways Co., and has given excellent results; the accompanying illustration shows the truck of this car with the brake gear in position.

Mr. Henry M. Sayers inspected the car on June 16th last, and tested the performance of the brakes; as his report contains a good general description of the brake, we give below some extracts from it:—

The Freund brake belongs to the mechanical slipper class, the actual brakes being wooden blocks applied to the tables of the track rails.

The braking power is obtained from two or more helical springs which surround a rocking shaft carried across the truck, which turning one way presses the brake blocks on to the rails, and turning the other, lifts them off the rails. The ends of the springs are housed in two gear-wheels concentric with the rocking shaft, one of which is connected to it by a planet gear controlled by two band brakes on drums. When the springs are wound up they tend to turn the rocking shaft through the gears in the direction to apply the brakes. Releasing one of the band brakes permits such application. The release of the other band brake allows a pull-off spring to rotate the shaft in the opposite direction, raising the blocks from the rails. In both operations the manual effort is confined to releasing the band brakes by a light pull on one or the other pull-rod or cord.

The springs are wound up by a connecting rod driven by an eccentric on one of the car axles, by means of a pawl and ratchet wheel geared into one of the wheels carrying the ends of the springs. The amount of the winding is limited by a threaded sleeve sliding on the ratchet wheel spindle, which lifts the pawl out of gear when the sleeve reaches a predetermined point. The movement of the sleeve is proportional to that of the springs, and it is moved to or from the disengaging point proportionately to the winding or unwinding of the springs. The movement is not unlike that of some steam steering gears as applied to the shifting of the valve gear.

In the car inspected the gearing is such that the spring is fully wound up while the car is travelling a distance of about 90 yards (or 32 revolutions of the driving wheels) and is fully unwound after making four successive brake applications. But when travelling, the winding of the spring commences immediately after each application of the brake and continues until the car stops, so that some of the braking power is restored even during the braking time.

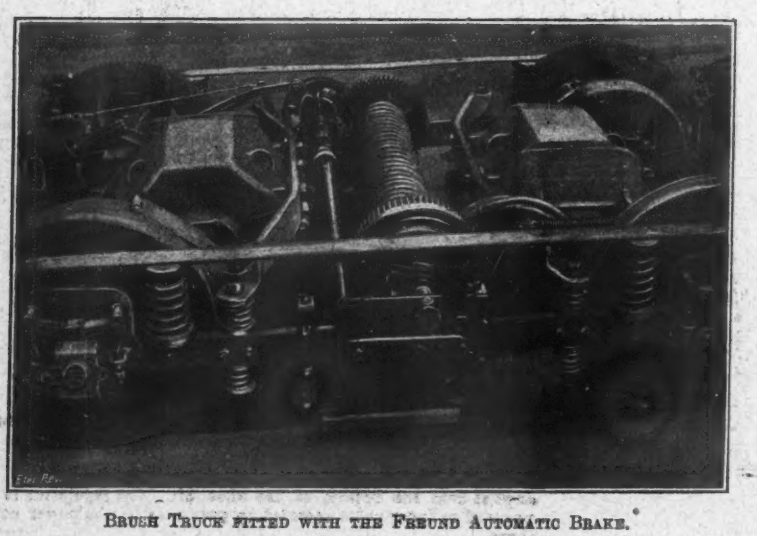
The springs fitted to the car examined are two in number, made of 1-in. diameter round steel coiled to a diameter of about 7 in. These springs give an effective pressure on the brake blocks of about 4 tons. The pressure in any particular case is dependent upon the strength of the springs, the initial set given them, and the leverage between the shaft and the brake blocks, and can therefore be set to give the most effective division of weight between the track blocks and the wheels. The wear of the blocks is automatically compensated for by a device which keeps the stroke of the depression lever (and consequently the pressure on the blocks) nearly constant; and also economises in brake blocks by permitting their use up to the minimum safe thickness.

The car to which the brake is fitted is a double-decked top-covered car carried on a four-wheeled "Brush" truck, of 4 ft. 8½ in. gauge. The car weighs about 9 tons. The brake blocks therefore take about 44 per cent. of the car weight, leaving 56 per cent. on the wheels.

The platform gear consists of an upright spindle fitted with a removable lever, which applies the brake when pushed forward; and a hand wheel which releases the brake when turned in one direction. The hand wheel is used because it was already on the car, and it may be replaced by a second lever, or it is possible and preferable to use a single lever for both application and release. Each action requires a light pull of small extent upon a pull rod or cord, involving about as much exertion as ringing the conductor's signal bell. The brake can be applied from either end of the car under all conditions.

The mechanism employed occupies about 18 in. lengthways of the truck between the two motors, not materially more than that occupied by the hand-applied track brake gear; and in addition about 3½ in. length of one driving axle. There is no difficulty in accommodating it on any pattern of truck in general use. The design is substantial, and all the parts are of a character adapted to cheap manufacture and erection in quantity. The pressures are applied in a fairly direct way without excessive leverage ratios, and I am of opinion that neither breakage nor seriously rapid wear will occur, with reasonable care in manufacture.

Mr. Freund's invention provides a brake having all the powers of the air worked track brake, but calling for the provision of no special form of power or power storage beyond a pair of helical springs; at once cheap, light, of small bulk, and not liable to leakage. Subject to the questions of durability, which can only be settled by service use, I am of opinion that this brake is a valuable addition to the resources of the tramway engineer, that it can be cheaply applied to all the usual types of car, and that it should find a large immediate application.



Brush Truck fitted with the Freund Automatic Brake.

I made a considerable number of tests of the brake upon a gradient varying from 1 in 12 to 1 in 25, at speeds varying from 8 to 22 miles per hour, and upon rails both dry and greasy, with results showing that the mechanism makes prompt and effective use of the available pressure and frictional coefficient of the blocks. In order to test the value of the winding of the springs during braking, I had some special tests made with repeated applications during the stopping intervals, which gave excellent results, showing a power which is not possessed by any other brake within my knowledge of reducing the stopping time and space in extreme cases. I also made some tests of the brake as a "coasting" brake, allowing the car to descend a steep gradient at a steady regulated speed. The result was again excellent, although the driver had no training in this particular use, and showed that the car is kept under effective control without acceleration on long descents, the safety condition for working heavy hill routes.

The tests showed that the Freund brake answers excellently the purposes of a service brake, an emergency brake, and a hill or coasting brake; and as it does not interfere with the auxiliary use of the wheel brakes, nor is it affected by the abuse of those brakes even to the skidding point, nor is there any mutual interference between it and the electrical equipment, it is, in my opinion, a long step towards the ideal brake for tramway purposes.

Messrs. E. A. Paris, managing director, and R. C. Goldston, engineer of the tramways above-mentioned, have also reported very favourably on the performance of this brake, and of a similar spring-applied, but hand-wound Freund brake, which has been in use on their lines since October, 1906. It appears that the car fitted with the latter has not been reported for repairs for over 18 months, while the motors and other parts of this car have required a minimum of attention during the whole period. Messrs. Paris and Goldston say:—

"We find that all claims made for the Freund brake system are substantiated by our experience with it, but we consider five points worthy of special notice, viz.:—

"1. That there is no possibility for the driver to make a mistake in operating it, as this brake requires no special thought, being under all circumstances worked in the same way.

"2. That a car ascending a gradient, heavy or otherwise, can be stopped before it runs back at all, in the event of current failing or other defect.

"3. That ordinary shed labour can attend to it, as there are no adjustments to be made while 3½ in. blocks are being worn out.

"4. That it can and is intended to be used in conjunction with the ordinary hand brake.

"5. That it can be applied by conductor or passengers independently of and, if necessary, at the same time as by the driver.

"With regard to the brake-gap regulator with which car 42 is equipped, we are pleased to say that it works very well and that it fulfils a pressing want."

Considerations of space prevent our giving here a detailed description of the ingenious mechanism devised by Mr. Freund to secure these results. Amongst the claims made for his brake are the following:—

Simplicity and reliablity.

Complete stops as easily obtainable as speed regulation for coasting.

Highest braking effect combined with a minimum of work and responsibility of the motorman.

Track and wheel brake are independent of each other, and neither hand nor foot of the motorman being engaged with the track brake, the wheel brake can be put on simultaneously with it. If one fails the other is already on and prevents serious consequences.

The Freund brake can be applied from any part of the car (or train), and simultaneously from several points without causing any trouble. (Should the driver suddenly get disabled, a stop can thus be promptly effected by conductor or passengers.)

The Freund track brake can be applied before a car enters a dangerous down grade (this is impossible with electric and magnetic brakes, as motors cannot simultaneously move the car on to the gradient and excite the brake magnets).

Freund brakes are as suitable for service as for emergency purposes. The most rapid stops can be effected without the least discomfort to passengers and without objectionable strains to the rolling stock.

Skidding of wheels overcome.

Low first cost.

The motors are allowed to cool down while the cars are descending gradients, enabling smaller motors to be used with the Freund brake than with magnetic or electric brakes.

The following are some of the tests on Car No. 42, with the axle-wound Freund brake, on gradients varying from 1 in 12 to 1 in 17:—

No.	Rail.	Blocks.	Speed M.P.H.	Distance to stop.	Time in seconds.	Brakes used.	
1	Dry	Wood	18	29 yds.	4	Track brake	No sand
2	"	"	22	36 "	3½	"	Sand
3	"	"	20	25 "	3½	Track and	No sand
4	"	"	24	33 "	3	hand brake	No sand
5	"	"	20	22 "	3½	together	Sand

No.	Rail.	Blocks.	Speed M.P.H.	Distance to stop.	Brakes used.
1	Greasy.	Wood	9½	4 yds.	Track and
2	Rain	"	13	10 "	hand to-
3	falling	"	16	14 "	gether
6	at	"	22	30 "	"
7	com-	"	8	4 "	Track only
8	mence-	"	12	14 "	"
9	ment.	"	19½	45 "	"
10		"	22	54 "	"

THE CANADIAN NIAGARA POWER CO.'S DEVELOPMENT.

SOME interesting data regarding the work carried out by the above company are contained in the August *Proceedings* of the American Society of Civil Engineers, in a paper by Mr. A. H. Van Cleve. The author discusses the general history and scope of the undertaking, and describes in detail many interesting features of the hydro-electrical installation.

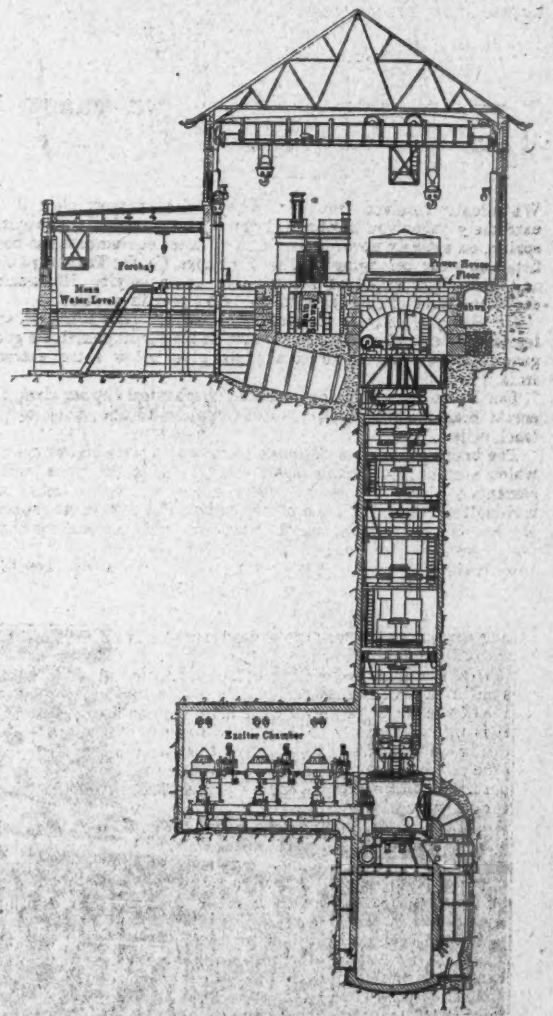
It will be sufficient here to state that the Niagara Power Co.'s plant was placed, by agreement with the Park Commissioners, in the Queen Victoria Niagara Falls Park, on the edge of the river a short distance above the crest of the Falls.

The power house, a fireproof building, stands over a wheel pit some 566 ft. long, 171 ft. deep, and 20 ft. wide, excavated for two-thirds of its depth in limestone rock and the lower portion in shale. The wheel pit is lined with brick, and the bottom slopes towards one end where the entrance of the discharge tunnel is situated. This tunnel, some 2,164 ft. in length, 25 ft. high, and 18 ft. wide, has an exit below the falls near high water mark; it is lined with brick for the greater part, but granite is used where the water velocity is high.

The water reaches the power house through a short canal, terminating in a forebay protected by ice racks. From the forebay short tunnels lead to 10 ft. diameter vertical penstocks, which are provided with cast-iron elbows at the top and cast-steel elbows at the bottom where they connect to the wheel cases. The available head of water varies from 130 to 136 ft.

Six floors are provided in the wheel pit, the turbines being situated above the lowest one. Double Francis turbines are used, five units each of 10,000 H.P. normal output at 250 R.P.M. being installed in the portion of the plant so far completed.

The wheel case is of steel plate, 13 ft. in diameter, and the water passes into the central cast-iron draught case, through upper and lower bronze runners, each 5 ft. 4 in. diameter; the discharge takes place through a 5 ft. 3 in. draught tube on either side, which



SECTION THROUGH POWER HOUSE AND WHEEL PIT, SHOWING 10,000-H.P. TURBINE AND GENERATOR.

empties into the bottom of the wheel pit. The regulation is by means of cylinder gates operated by governors in the power house above.

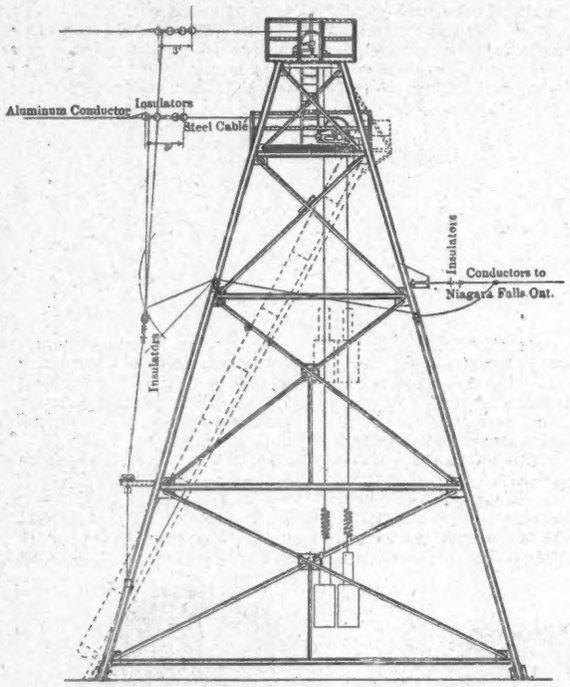
Special interest attaches to the method of supporting the revolving mass of the hydraulic and electrical machinery, weighing some 240,000 lb. This is achieved partly by connecting the underside of the lower runner to the wheel case, and the upper side of the top runner to the draught case, thus obtaining an upward pressure on the wheel due to the water head. A further balance piston is fitted above the turbine, supplied through a 12-in. pipe from above, and controlled by valves. As the exact balance of the revolving parts is a matter of some difficulty due to changing conditions of load, an oil step bearing has been provided on the floor immediately below the power house. This consists of two 3-ft. diameter disks of charcoal iron, one stationary with a spherical seating and the other revolving with the shaft; oil at a pressure of about 100 lb. per sq. in. is forced into grooves between these disks by a special pump driven from the main shaft. It may be noted that the surfaces of the disks were finished with emery and chalk.

With a view to determining the maximum capacity of these prime movers, a series of tests was carried out at full load, the average distribution of losses, with a 134 ft. head, being as follows:—From forebay to upper elbow, 8·33 per cent.; vertical penstock, 0·34 per cent.; lower elbow and wheel case, 11·83 per

cent; friction loss in draught tubes, 11·30 per cent.; energy loss in discharge, 18·95 per cent.; in turbine wheel and mechanical losses, 49·25 per cent. From the data obtained, it was calculated that 11,500 H.P. represented the maximum available power.

An elaborate oil circulation is in use for lubricating the seven guide bearings on the main shaft of each unit and other parts. Pressure oil is required for the governors and step bearings, the former being supplied at 225 lb. per sq. in.

The five main generators are of the revolving-field type, giving three-phase current at 12,000 volts pressure and 25 cycles.



Steel Tower for Niagara River Span, showing Counter-weight Arrangement.

Exciting current at 125 volts pressure is supplied to collector rings situated immediately below the shaft coupling.

Three exciter units, consisting of 200-KW. vertical shaft generators mounted over Francis turbines, are installed in a tunnel on one side of the wheel pit, level with main turbine floor; a similar tunnel is provided for the oil pumps for supplying the lower lubricating system, and all the floors in the wheel pit are coupled up to the power house by means of a hydraulic lift.

From the main generators energy passes through double-throw selector oil switches to four sets of bus-bars.

The operating board contains five generator and 20 feeder panels in addition to meter and interconnecting panels, and each panel is complete in itself. The outgoing feeders run in two directions in underground 32-duct conduits, one leading to a steel arch bridge across the river, and the other to a local transformer house.

The former group of feeders interconnects the plant with the Niagara Falls Power Co.'s station on the American side, and the latter transformer station, which has an equipment of 11,000/2,200-volt and 11,000/22,000-volt transformers, is principally engaged in supplying 22,000-volt current to the Cataract Power and Conduit Co. in Buffalo, by means of overhead transmissions.

The Buffalo transmission consists of one pole line, carrying two 12,500-H.P. circuits; the insulators are of electrose, and the conductors are 500,000 C. mils aluminium with 37 strands.

The poles, which are usually of steel, are spaced at 300 ft. intervals, with one or two exceptions. Reinforced concrete and special structures were necessary at railway crossings, &c., and the arial crossing over the Niagara river at Buffalo required special towers.

The respective Governments required a 130 ft. headway over the river, and to obtain this three towers are employed with heights of 61 ft., 203 ft., and 151 ft. Owing to the configuration of the ground, the tops of the two higher towers are practically level; a 1,667 ft. span was required in the first case, and a 2,192 ft. span in the second case, which passes over the river to the terminal house in Buffalo. Concentric lay 61-strand aluminium transmission cables are employed, attached rigidly to the central tower, and coupled at the other towers, through insulators to steel cables, which pass over sheaves, and at their extremities are attached through springs to counterweights; this arrangement is designed to equalise temperature and wind effects on the river transmission. Bus-bars are installed on the towers, and switches are provided to connect up any pole-line circuit with any long span circuit.

Many difficulties were encountered in installing the long spans; the aluminium conductors were so soft that they could not be passed under stress over snatch blocks, owing to abrasion and the tendency to unstrand. Two large hoisting engines were employed, one on each side of the river, and the aluminium conductors were pulled over the towers by means of a steel pilot cable which had been previously drawn across the river.

The author concludes that future enterprises of this description will be more easily carried out, owing to the introduction of copper-plated steel wire conductors and similar improved transmission cables.

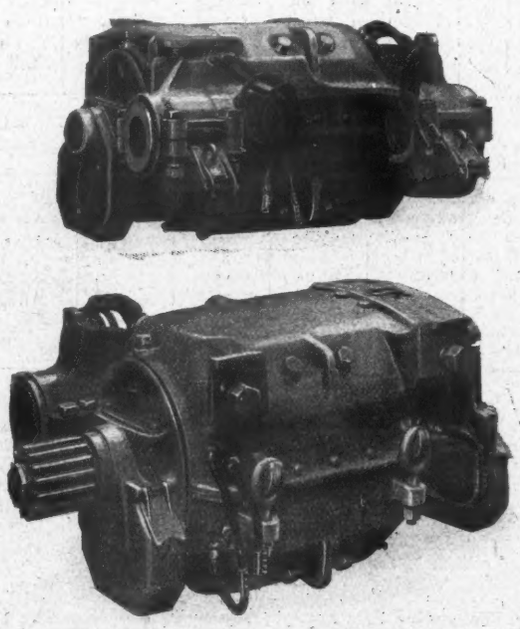
MESSRS. DICK, KERR & CO.'S INTERPOLE TRACTION MOTORS.

The requirements of modern electric tramway practice are much more exacting than those of earlier years, and to meet them necessitates special apparatus. With a view to meeting these more onerous conditions, Messrs. Dick, Kerr & Co. have developed a series of "interpole" motors, embodying a number of new points in design and construction, and superior in many ways to the older type. Such motors are particularly suitable for tramway systems where extensive use is made of electric braking, and in any circumstances where the duty is more than ordinarily heavy. They are sparkless under practically all loads, cool in operation, and oil proof.

Sparkless commutation is ensured by the addition of the "interpoles," thereby increasing the overload capacity and reducing the wear of the commutator and brushes; in some cases the motors will stand as much as 100 per cent. overload without injury. Further, the reduced wear of commutator and brushes, combined with improved methods of ventilation, result in the motor being very clean running, and free from flashovers and kindred troubles. In general, it may be said that these interpole motors will operate with complete satisfaction under conditions which would seriously embarrass motors of equal power, but unprovided with interpoles.

The motors are rated in the usual way, *i.e.*, on the output, including gear losses, for one hour with a temperature rise in any part as measured by thermometer, not exceeding 75° C. above that of the surrounding atmosphere, the temperature of which does not exceed 25° C.

The field frame is made in the usual form of two bowl-shaped castings of soft steel of high permeability, thereby securing the smallest possible weight. The two halves are fitted together with



Dick, Kerr Traction Motor.

a carefully machined joint to ensure a good magnetic circuit, and to make the frame both watertight and dustproof. The lower half of the frame is hinged to the upper half, thus permitting the lower field coils to be easily inspected and cleaned.

Each armature bearing box is contained in a separate solid casting independent of the motor frame altogether, it being held in position in the main motor frame by means of a tongued and grooved joint and firmly fixed by studs. The armature can therefore be lowered with the bottom half for inspection, or can be retained in position in the top half as may be desired. It can further be removed from the main shell with its bearing boxes complete, if occasion requires it. The fact that the bearing boxes

for the armature are solid, is regarded as a valuable feature of the design, as it effectually prevents oil from the bearing creeping into the interior of the shell, thus making the motor practically oil proof.

The main pole pieces are made up of laminated sheet steel punchings riveted together, and are bolted to the inner surface of the frame. The pole pieces are interchangeable, and can readily be replaced in case of repair.

Special arrangements are made for supporting the main field coils, two flat steel springs, each capable of exerting a pressure of about 400 lb., being inserted between the field coil and the shell. The coils are held in place by the pole shoes themselves, and brass washers which cover the surface of the coil. As each coil is thus forced against the brass washer by the springs with a pressure of nearly 800 lb., any shrinkage of the coil is automatically taken up, and the coils are at all times held rigidly in position. Mechanical troubles in this portion of the motor are thus practically eliminated.

The interpoles are solid steel, situated symmetrically between the main poles and fixed in position by rivets. The interpole field coils are clamped in position by independent screws, which are locked to prevent any movement. The ends of all field coils are finished off with strong bronze terminals for inter-connection after they are assembled in the motor frame.

The armature core is built up in the usual way, with distance pieces to permit free circulation of air. Specially good ventilation of the armature is ensured by means of the fanning action of the connections between the armature coils and the commutator bars. These connections are made of thin flat copper strips, which, when the armature rotates, act as fan vanes and draw a current of air through the motor. The air enters through the opening on the top of the shell at the gear end, and is drawn towards the centre of the armature core, passing through the end winding at the gear end, the armature core, the end winding at the commutator end, and finally passing out of the shell at the opposite end. This artificially produced draught is so effective that it enables a motor to run fully 25 per cent. cooler than would be possible otherwise. The fan action is centrifugal, and therefore independent of the direction of rotation.

This method of construction has the additional advantage of enabling the armature leads to be carried straight to the commutator risers, which greatly simplifies matters when it is required to remove the commutator, as the complete winding is left intact. All that is necessary in order to remove the commutator is to unsolder each conductor and bend it slightly upwards. The commutator can then be pulled off without any disturbance of the armature winding.

The bearings and the method of lubrication employed in the Dick, Kerr interpole motors are specially worthy of attention. As previously indicated, the armature-bearing boxes themselves are solid castings, entirely independent of the main motor frame. They are made to gauge, and interchangeable, as are also the bearing brasses themselves, which are of ample proportions for the work they have to do.

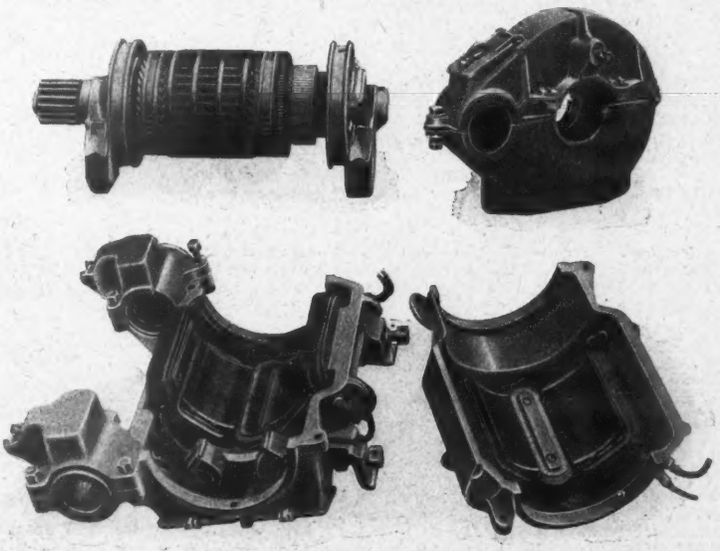
A constant and efficient supply of oil to the armature bearings is secured by employing oil rings, which have been found by actual practice to be superior to any other method of lubrication. The oil after use in the bearing is drained back to the reservoir by large drain channels, which have sufficient capacity to take care of the maximum amount of oil which can possibly be supplied to the bearings. Special oil throwers are provided to deal with the small amount of oil which is not taken care of by the main drains, the oil from the throwers also being drained back to the oil chamber. After the bearings have been filled with oil, they will run with safety for a considerable length of time without attention; it is quite safe to allow such bearings to run for a fortnight without oiling, although it is better practice to have a regular system of oiling once a week.

Special chambers are provided below the oil reservoir, and into these chambers, any oil which is not returned to the main reservoir drains. The bottom of each chamber can be closed by a cover, and when this opening is closed the motor can plough through almost any depth of water without getting flooded.

The axle bearings are also lubricated by means of oil, but in this case a wick arrangement is employed. These bearings will also run for a fortnight before requiring refilling, and arrangements are provided for allowing the wick to be quickly and easily withdrawn. Two helical springs acting on the wick holder, press the wick against the axle; two springs are provided to ensure that the lubrication is not interfered with should one spring fail from any cause.

The armature bearings are made of special anti-friction bronze, the axle bearings being also of bronze or malleable iron lined with best white metal, as may be desired.

The whole of the gearing is contained in a malleable iron case in two halves, which is specially designed to withstand heavy vibration, and is supported at three points. All bolts are of the same size, and are locked from turning by special lugs cast on the frame and gear case. The nuts are also locked by spring washers.



DETAILS OF DICK, KERR MOTOR.

THE SENLECQ-TIVAL METHOD OF PHOTO-TELEGRAPHY.

A NEW method of transmitting photographs to a distance has been recently introduced by MM. Senlecq and Tival. It is distinguished from the existing methods of Korn, Carbonelle and Belin by the fact that the actual transmission is only a matter of a few

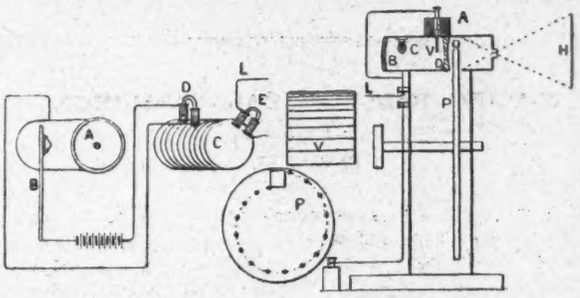


FIG. 1.

FIG. 2.

seconds instead of taking 30 or more minutes. This is an important improvement, in view of the congested state of most trunk lines. The high speed is attained in this case by first converting the actual photographic picture into a magnetic picture at leisure without using the line at all, and then transmitting the magnetic picture along the line when convenient and at a very high speed.

In this way the procedure is similar to that of the Wheatstone high-speed telegraph with its perforated paper strip. The Senlecq-Tival process starts with a bichromate gelatine photograph. This is impregnated with a metallic powder, in a way which is at present kept secret, until the variations of light and shade in the picture correspond with variations in electric resistance of the conducting surface of the picture. The variable resistance is made to cause the current from a constant-pressure local battery to vary. These current variations are recorded magnetically on a steel wire, as in the telegraphone. This magnetic record can then be stored away for any desired length of time, and can be employed to reproduce the current variations in a suitable circuit when required.

The speed at which the magnetic picture on the steel wire can be transmitted is considerably greater than that at which it can be impressed on the wire in the first case, and is only limited by the inertia of the receiving instrument. The latter consists essentially of a sensitive galvanometer, the deflections of which are magnified by a lever arrangement. The galvanometer actuates a small (1 sq. mm.) very thin film screen, which is shaded off from complete opacity to complete transparency by a micro-photographic process. In this way the light falling on a rotating disk from a Nernst lamp is varied in intensity in accordance with the deflection of the galvanometer. The disk is perforated with holes lying on a spiral. If the disk in the receiving station rotates synchronously with the telephone drum in the transmitting station, it is easy to see that the variations in illumination finally received on a photographic plate will correspond with those in the original photograph.

Referring to fig. 1, A is the transmitting cylinder carrying the prepared picture; B the contact point for transmitting the current through the varying resistance of the picture; C the telephone drum; D the telephone electromagnet; E the transmitting magnet; L the line. In fig. 2, A is the galvanometer, B a mirror, C the Nernst lamp, D a bi-concave lens, H the receiving screen, P the rotating

perforated disk, v the shaded screen. End elevations of p and v are given to the left of fig. 2.

It is not known whether any actual working results have as yet been obtained by this process.

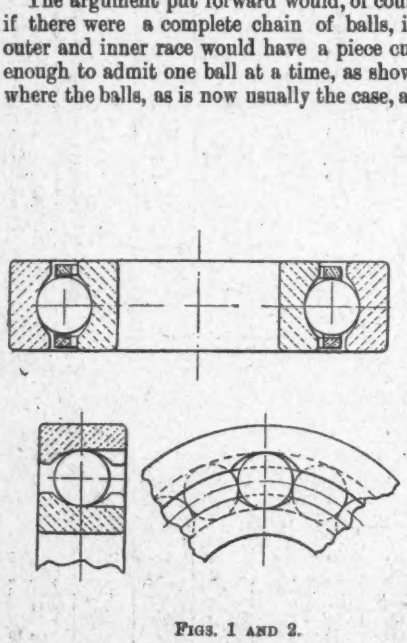
If it were possible to still further reduce the time of transmission to, say, one-tenth of a second, it would be possible, owing to persistence of vision, to dispense with the photographic fixing of the received picture, and to view the picture direct on the screen, whilst it was being produced by the rapidly moving spot.—*Der Mechaniker.*

PLACING BALLS IN BALL BEARINGS.

By SILENS.

Now that ball bearings are coming to the fore for use on electrical machinery, and as, when showing ball bearings on drawings, as in fig. 1, I have several times been accused of showing them wrongly, the argument put forward being that it was impossible to get the balls into position between the two races as shown, I think the following short description of how this may be accomplished may not be out of place.

The argument put forward would, of course, be quite right if there were a complete chain of balls, in which case the outer and inner race would have a piece cut away just large enough to admit one ball at a time, as shown in fig. 2. But where the balls, as is now usually the case, are kept apart by a distance ring, this cutting is unnecessary, for most bearings are now so designed that by placing one part of the outer edge of the inner race in contact with the inner edge of the outer race, as shown in fig. 3, there is just room to admit one ball at a time at the point directly opposite the point of contact, as shown by the dotted ball, and each ball is fed round by the next one put in, until they take up the position shown. The inner race is then pulled into a central position, and the distance ring put into place, thereby spreading the balls equally round the races, as shown in fig. 4, and when the distance ring has been riveted over, the bearing can be lifted by either the inner or outer race without dropping the balls out, or injuring the balls in any way.



Figs. 1 and 2.

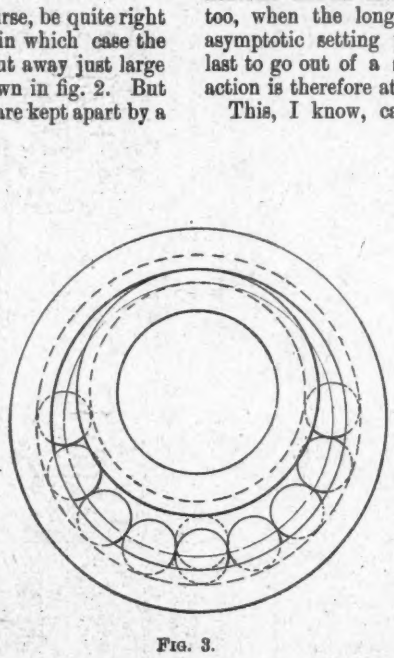


Fig. 3.

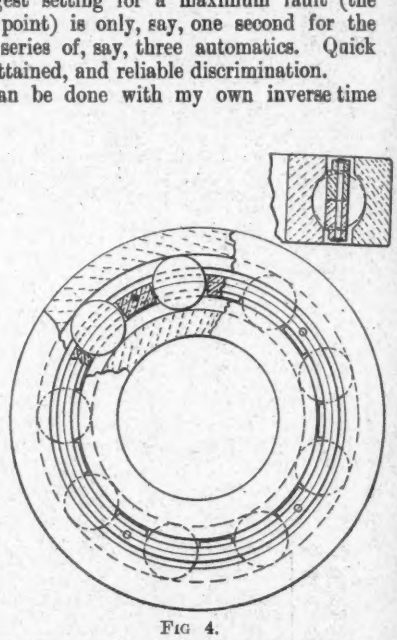


Fig 4.

Boiler Works for Sale.—It is stated by the *Financier* that the Queensferry Works, near Chester, are to be sold by public auction on September 16th at Tokenhouse Yard, by Messrs. Wheatley Kirk, Price & Co. These works were completed some five or six years ago by Messrs. Willans & Robinson, Ltd., of Rugby, for the manufacture of the Niclausse boiler and high-class steel for consumption in the works. After a few years, however, the directors gave up the construction of the boiler, and it has now been decided to sell the place complete. The works cover about 40 acres of ground on the banks of the Dee.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Merz-Price System of Automatic Protection for High-Tension Circuits.

I notice in the article appearing in your issue of August 28th, and giving an excellent description of the above system, it is stated that "with the ordinary system of feeder protection, including overload with inverse time limit and reverse current relays, a heavy fault on an outlying cable or on the machine will often indiscriminately open switches in various sections of the system between the fault and the power station. . . ." I observe the saving words, "ordinary system," which is sufficiently vague, but I fear that the general trend of the article might give a false impression to the reader, and lead him to suppose that even with the best overload time lags (or limits) indiscriminate opening is likely to take place on the occasion of a bad fault. This is not so; perfect order of operation can be obtained on the heaviest known faults with inverse time lag relays. This, too, when the longest setting for a maximum fault (the asymptotic setting point) is only, say, one second for the last to go out of a series of, say, three automatics. Quick action is therefore attained, and reliable discrimination.

This, I know, can be done with my own inverse time lag relay, and I think that makers of the best forms of induction-type relays might have somewhat similar remarks to make about theirs. It is true that, in the past, protection by inverse time element and reverse relays has been attempted with unsuitable devices, and I dare say that the author has cases in his mind that support his statement.

But the broad fact remains that present-day inverse time element and reverse current relays are quite able to give full and satisfactory protection, and do not fail as stated in the article referred to.

J. G. Statter.

Birmingham, *September 2nd*, 1908.

Colliery Cable Practice.

"D. A.'s" remarks are very welcome, as it is hoped that they will lead to a thorough ventilation of the vexed question of colliery cables. That there is a wide diversity of opinion on the matter is evident from the variety of types used under almost identical conditions with, as might be expected, as various results.

"D. A." recommends paper-lead-covered cables for the shaft, "a bitumen cable being wholly unable to carry its own weight without damage," but he recognises the danger of the corrosive action of mine water on the lead. It is not

fair on his part to condemn bitumen cables in this sweeping fashion, simply because the makes he has used are too soft for shaft work. I admit that I know of only one make which is strong enough, but there are a great many shaft cables of that make, both at home and abroad, which have been installed without difficulty and are working perfectly. In some cases the cables are suspended from the top without other support for as much as 300 yards. It is, therefore, not necessary to run the risk of using paper cables in a shaft.

His caution with regard to end boxes is well founded; they are a source of danger and expense. Why not do without them altogether? Use a cable with a complete non-hygroscopic insulation, such as bitumen; the cores can be opened out and taken into fuse or switch without the expensive end box and tails. For suspending road cables I have found canvas bands, say, two inches wide, very satisfactory and cheap; they are specially useful with soft insulations, and are preferable to twine, rope, or pigskin.

The precaution most neglected in collieries is that of earthing armourings, motors, resistance cases, &c., and I am convinced that electrical working in collieries will not be generally safe until the Home Office appoints electrical engineers (they are cheap enough) as special inspectors, to ensure that its rules are intelligently carried out.

A. F. S.

Metal-Filament Lamps.

I can fully endorse the remarks made by Mr. Sowter in his letter of last week. Everyone who has the interests of electric lighting at heart naturally wants to see a progressive policy pursued, but this can never be attained by charging 4s. each for Osram and other metal-filament lamps. It has long ago been proved up to the hilt that it's the popular price which pays, and if manufacturers would come down to a reasonable figure for these lamps, viz., not exceeding 2s. each, they would find such a demand for them that their output would exceed their most sanguine expectations.

My experience, after making a most careful canvass amongst the best class of people in this city (including consumers and would-be consumers), is that 4s. each for lamps simply kills the business, the saving in the accounts notwithstanding.

Arrangements for this season's lighting are proceeding apace, and I trust this matter will receive early attention, as there are undoubtedly scores of installations throughout the country which may be secured to us in lieu of our competitor "gas," but no time should be lost.

John Jones.

Bristol, *September 7th*, 1908.

The points raised by "Contractor" in your issue of August 28th should promote a discussion regarding the existing conditions of the sale of metallic-filament lamps, which I trust may do good. So long as contractors and manufacturers fail to realise that each has his own department, and that the latter cannot exist without the former, or *vice versa*, neither the lamp portion or any other branch of the business can be in a satisfactory condition.

The manufacturers have had to make a large initial expenditure in perfecting, developing, and introducing these lamps, and are entitled to earn these outlays as expeditiously as possible, but, on the other hand, retailers are just as much entitled to be recouped for their labours, and to be assured of such a margin of profit as will fully cover their risk of loss by breakage, stocking, and handling the goods in small quantities after they have become their property.

The managers, directors, and officials of large manufacturing or wholesale concerns, are not themselves in a position to judge what is a legitimate profit for a retailer, who may have to sell the lamps in lots of one, two or three at a time—as they cannot fully grasp the risk and trouble entailed, they themselves being so much accustomed to dealing with large quantities. In the present instance the margin of profit having been fixed by the manufacturers and wholesalers, and retailers finding it a losing game to handle these lamps, where do the said manufacturers, &c., expect the retailers eventually to find the money to pay them for the lamps?

Yet Another ——

Rail Corrugation.

In reply to Mr. E. Cloney's letter, which appeared in your issue of July 31st, I regret to state that I have not derived any amusement by reading his antiquarian story, nor can I see that it can be offered in any way as a similarity to the number of rail corrugation theories. Perhaps it is my dull sense of humour that prevents me from viewing the story from the same standpoint that Mr. E. Cloney does, when reading rail corrugation theories that have been put forward by various tramway managers. It must be that rail corrugation does not affect Mr. E. Cloney professionally, nor can he be financially interested in any tramway system; if he is, and could only be led to see what a reduction the absence of corrugations would make in the repair account for one year, he would, I think, be much surprised.

The account of Prof. Carus-Wilson's paper at the Tramway Congress, which appeared in your issue of the 24th ult., is most interesting, and I think that his theory on short corrugations points to the adoption of a differential drive for car axles. My own theory, to prevent long corrugations, is—solid wheels.

If it were possible to equip tramcars with pneumatic tires, I feel sure the solid axle would not be tolerated for a year on any undertaking. The system of returning the current to the rails *viâ* revolving spoked wheels is also crude. I have tried to devise suitable wheeled skates, so that the current could be returned to the rails by this means, in place of the car-wheels; but, so far, owing to the restricted room under a car, I have been unable to design a satisfactory arrangement. The trouble, principally, is the short life of the skate wheels.

Should any of your correspondents wish, I shall be pleased to forward them photographs of the attachment.

J. F. Jones.

Madras, *August 20th*, 1908.

Several letters have been received too late for inclusion in this issue.—Eds. E R.

THE BRITISH ASSOCIATION MEETING AT DUBLIN.

In point of numbers the Dublin meeting of 1908 was successful, for up to the evening of Thursday, the second day of the proceedings, the attendance was close upon 2,250, a figure slightly in excess of last year's total at Leicester, or that of the preceding year at York. The city of the low-backed car and the bare-foot boy has extended its hospitality to the Association with that liberality which goes so far to make both enjoyable and successful a meeting of this kind. To the authorities of Trinity College, for the very convenient accommodation of the various Sections in close touch with each other within the College grounds, the Association is especially indebted. Only a few of the Sections were meeting in other parts of the city, and in order to provide ready access to these a special motor-car service was instituted for the first time.

One little incident that may be mentioned in passing may serve to raise a smile. Over the entrance to Trinity there had been placed a hoarding bearing the words "BRITISH ASSOCIATION" in big bold lettering, indicating that it was the headquarters and general meeting place. This caused keen displeasure in some quarters, and on the morning after the delivery of the presidential address, a letter appeared in the *Irish Times* from "J. P. Mahaffy," saying that he was assailed by every post with "such violent protests from intelligent citizens and lovers of the College against the deforming of our great front by a hideous advertisement that I am compelled to appeal to you to publish my answer. I have not the power to order its removal; if I had, it would not remain there five minutes." The hoarding remained there throughout the day in the drenching rain until nightfall, but with the coming of the dawn a transformation had taken place, the offensive hoarding having lost its latter end so that it read thus: "THE BRITISH ASS." Whisperings are abroad that some of the students of Trinity were the culprits, and one heard comments outside the entrance "Then they've let Mahaffy

have his way." This is one of the pleasantries of the Dublin meeting, and as the hoarding had served its purpose by the time it was removed, and as its removal gave so much satisfaction, then all's well that ends well.

The address of the president, Dr. Francis Darwin, was delivered at the Royal University on Wednesday, September 2nd, and its subject was movements in plants and the inheritance of acquired characters. The outgoing president, Sir David Gill, before introducing the new president, referred to the death of Lord Rosse, a most distinguished member of the Association, and also to the shade of sorrow cast by the death, since the Leicester meeting, of Lord Kelvin, whose influence, whose tremendous capacity of thought, whose geniality of character and whose sympathetic nature were, he remarked, well known in many departments of science. Dr. Darwin also prefaced his address by references to both of these losses. Concerning Lord Kelvin, he mentioned that he joined the Association in 1847, and was for more than fifty years a familiar figure at the meetings. He alluded to his late lordship's great influence upon those who were personally unknown to him. It was characteristic of him that his personal charm was experienced far beyond the circle of his intimate associates, and many who were in outer darkness as to Kelvin's researches and had never exchanged words with him, would miss his genial presence and feel themselves poorer.

Thursday, September 3rd. In Section A (Mathematical and Physical Science) Dr. W. N. Shaw, F.R.S., the chairman, delivered his address, but before doing so he alluded to the services rendered by the late Lord Rosse in connection with the dispute between the L.C.C. and the Observatory authorities two years ago, regarding the position of the electric generating station at Greenwich, his lordship's work on the committee which was appointed to consider the matter, being of the greatest value and assistance. The work of Lord Kelvin, as a mathematician, as a natural philosopher, and as a University professor, was also mentioned. Later, in this Section the report of the Committee on Magnetic and Meteorological Observations was considered and adopted, and the committee was reappointed. A report by the Committee on Magnetic Observations at Falmouth Observatory was also adopted and the committee was reappointed, with Sir W. H. Preece as chairman and Dr. R. T. Glazebrook as secretary. To these committees grants of £25 and £50 respectively were made. The report of the Electrical Standards Committee (Lord Rayleigh, chairman) was submitted by Dr. Glazebrook. In the Chemistry Section, Prof. Kipping, F.R.S., took as the subject of his address the chemical industries of Great Britain, and the steps to be taken to put them into a more prominent position than that now occupied by them. Among other matters he referred to the New Patents Act which, though valuable in many respects, would do little to foster the British chemical trade or develop British chemistry. Equality of patent rights was valueless unless we had something to patent, and the industries would decline, perhaps, more rapidly than before. Manufacturers did not see their way to employ chemists, and the paucity of openings did not attract students to chemistry as a profession. The chemical industry must continue to decline unless there were an increasing and ample supply of students. The chairman attributed the state of our chemical industries to the wrong views obtaining as to the functions and training of a works chemist. Industrial chemistry must have continuous and arduous research work as its foundation. Our chemical students instead of *advancing the interests* of the industry, had to be content with *merely subsisting* on it. We were afraid to spend money upon research work. These and similar sentiments formed part of an extremely valuable and interesting address. In the Engineering Section, Mr. Dugald Clerk delivered his opening address, to which full reference was made in the ELECTRICAL REVIEW of last week (page 388), but before doing so he, like other sectional presidents, made a graceful and fitting allusion to the work of Lords Kelvin and Rosse. Following this, we listened to an abstract of Mr. Gerald Stoney's paper on "Recent Advances in Steam Turbines" (which appears on page 413 of this issue). There did not appear to be a burning desire to discuss the paper, but several questions were asked; Sir W. H. White made some remarks regarding the use of turbines in marine service, and Mr. Worby Beaumont and Mr. Dugald Clerk also contributed to the discussion, which very largely consisted in according praise to the Hon. C. A. Parsons and the engineers who had worked with him, especially the author of the paper.

In the Economic Science Section, Sir Oliver Lodge brought forward the subject of "Electricity in Agriculture," and he was followed by Mr. Priestley, of Bristol University College, who thought that the experiments showed that electricity could be applied not only to increasing the yield of crops, but to accelerating their growth. Prof. Barrett said that for a century and a half experimental study of the effects of electricity upon plant growth had been proceeding on the Continent. He thought, however, that Sir Oliver's experiments gave promise of important results being obtained.

Friday, September 4th. On Friday some of the members from Sections A (Mathematical and Physical Science) and B (Chemistry) met in the room of the Engineering Section for a joint discussion on the first report of the Committee on "Gaseous Explosions." For about an hour we were entertained by Prof. Bertram Hopkinson (one of the secretaries of the Committee), who gave an ample abstract of the contents of the report. We understand that the report itself may not yet be reprinted in the Press. The chairman (Mr. Dugald Clerk, also one of the secretaries), then announced that the discussion would be contributed to first by the physicists, next by the chemists, and finally by the engineers. He first read some comments that had been contributed by Prof. Callendar, and then called upon Dr. Glazebrook, as representing the physicists. This speaker congratulated the Association and the Committee on the work accomplished. It was the work of one year, and was very remarkable indeed. If they had not got any new experimental results, they had what was essential to work of that kind, a clear, and, he believed, accurate statement of the position of the problem at the present moment, and before any advance could be made it was necessary that they should have perfectly clear ideas as to what they knew at present as to what were the effects, and what other points required further experimental investigation. The report put those questions before them extremely clearly, and made it obvious what further points needed inquiry and what points they could take as fairly well established. The report was again interesting because it brought out very clearly the need for accurate determination of physical data conducted upon engineering lines. It was clearly not sufficient to attempt to solve those problems and obtain the data, necessary merely by the ordinary appliances of small physical laboratories. The problem had to be attacked upon engineering lines, but when that had been realised, the fact remained that the questions were mainly physical questions and chemical questions, and the aid of the physicist and the chemist was required. Speaking for the National Physical Laboratory, they would be glad to place their resources at the disposal of Dr. Harker, if he desired to further carry on his experiments in gas thermometry at very high temperatures. Dr. Harker, in response to the call of the chairman, then addressed the Section, referring chiefly to an article that he had seen in the *Wiedemann's Annalen* for September, showing that the Germans were accepting the platinum scale, and in this they were coming round to a view long held in England, and there was an agreement now which was extremely satisfactory.

Principal Griffiths, who followed, referred with satisfaction to the statement made by Dr. Harker, for he had never wavered in his belief in platinum thermometry. Sir A. Rucker, Prof. Harold Dixon, Sir W. H. White, Prof. W. E. Dalby, Captain Riall Sankey, and some others contributed to the discussion, after which Prof. Bertram Hopkinson and Mr. Dugald Clerk replied. The Section then adjourned until Monday.

Monday, September 7th. Perhaps the largest attendance in Section G was that of Monday, when peat utilisation and gas producers were the chief subjects under consideration. Captain H. Riall Sankey, R.E. (Ret.), M.Inst.C.E., first read his paper on "The Utilisation of Peat," in which, after referring to the revival of interest in the subject generally, owing to the developments in gas producers and gas engines, he mentioned its

interest to Ireland in view of the Irish peat gas electric supply scheme, which recently occupied the attention of a Parliamentary Committee, and which eventually passed in a modified form. It is proposed to put the power station alongside the Grand Canal at Robertstown, about 25 miles from Dublin, and it is hoped that the peat gas will be used for making electricity by means of gas engines and dynamos, and that electric power will be distributed to works which will probably be established within the prescribed area, because of the cheap power and water transport facilities that will be available. The progress made in peat utilisation in Germany was indicated, and methods of getting and drying peat were outlined. The various by-products came in for attention, the chief being sulphate of ammonia, the amount of which depends on the percentage of nitrogen in the peat. It is estimated that the Robertstown power station will be capable of making 3,000 tons of sulphate per annum. The author drew attention to the Canadian Government volume which had just been published, and he said that the conclusions which were arrived at therein agreed with his own.

The discussion on Captain Sankey's paper was deferred until two other papers had been read, namely, Mr. J. Emerson Dowson on "Producer Gas," and Mr. P. W. Robson on "The Production of Cheap Power by Suction Gas Plants." The three papers were then discussed together.

Mr. Wm. Crossley first addressed the meeting, making interesting remarks concerning estimates as to the very large profits that were to be made on the sulphate of ammonia, a profit of £6,000 per annum on an outlay of £50,000 capital being foretold, but he did not know what the cost of getting the peat would be in Ireland. He also referred to the important step forward that was being made in the designing of suction gas producers to burn bituminous fuels.

Mr. Alex. Siemens gave some information concerning certain suction gas producer work that he had been engaged upon at Inchicore, Dublin, as long ago as 1867. Referring to Mr. Crossley's estimate of profit on sulphate of ammonia, he said it was all very fine. He had seen such things before; but the public had got a very ugly habit of remembering such results, and if Mr. Crossley started his plant and wanted to sell his sulphate for £11, the public would ask, "If you can make it for £5, why should we pay £11 for it?" and the price would fall. Mr. Crossley interposed to say that any endeavour to regulate the market was not in the slightest degree possible.

Mr. Rigby addressed the meeting at some length, explaining a diagram of the peat utilisation plant, and describing briefly the means successfully employed by his firm to get over the trouble of tar in producers using bituminous fuel. He also explained the means that had been employed to get over the caking of the latter. Mr. Sherlock, who shed the sunshine of humour upon the morning's proceedings, referred to Mr. Crossley's promise to give them power for nothing. Mr. Crossley was also on the Canals Commission, and if they could get the power for nothing and carriage for nothing, Ireland would be the place for firms to go to who were coming in under the new Patents Act. He was afraid, however, that there was a slight error in many of the calculations, and they must go back to the bogs to learn a little more. He had come to the conclusion that peat was too valuable to burn. All the black peat was found only in the lowest layer of the bog, and to get it they had to remove a great deal, as, in order to deal with it, they had to get rid of the upper layers. The black quality peat which Capt. Sankey meant was really down below, and though it was very delightful to know that they could get their power for nothing, it was useful also to know that they had to remove two-thirds of the peat in producing it. Mr. Crossley replied that the nitrogen was really found in the top layer, and the speaker was incorrect. Mr. Sherlock responded that he had referred the matter to Prof. Moss, who advised him that there was nothing in the top. Capt. Sankey said that, with reference to the top spit of the peat, there were uses to be made of that. He understood that the profit on certain of the by-products, which he named, was sufficient to cover the cost.

After a few words from Mr. Dowson in reply, Mr. Robson said that, while there was undoubtedly very great prospect in the utilisation of peat, they must be careful to avoid a similar occurrence to that which they had witnessed at the Johannesburg station. In going in for big schemes before the thing had been thoroughly tried, there was great risk of things cropping up which longer experience would have shown it to be necessary to take into account.

Thanks having been accorded to the several authors, Mr. Walter Rosenhain addressed the Section on "The Study of Breakages," a subject upon which he is a high authority. The last paper for the day, that by Prof. E. Wilson, on "The Electrical Conductivity of certain light Aluminium Alloys as affected by Exposure to London Atmosphere," was taken as read. Several papers of electrical interest were read in Sections A and B. We shall give a full list of all the papers in our next issue.

(*To be concluded.*)

Recent Advances in Steam Turbines.

By Gerald Stoney, B.E., M.I.C.E., M.I.E.E.

(Paper read in Section G, September 3rd, 1908.)

Two years ago I had the privilege of reading a paper on "Steam Turbines" before this Section at the York meeting; but in view of the very rapid development of the steam turbine, both on land and for marine propulsion, it may possibly be excused if the same subject is once more brought before you. On land the progress of the steam turbine is to be seen in all directions, and one thing which is especially remarkable is the rapid increase in size. Eight years ago the largest one made, which was considered an immense machine at the time, was for only 1,000 kw., and now there are large numbers ranging from 5,000 to 8,000 kw. running and under construction.

Steam turbines of large size may be roughly divided into two classes, as the Laval turbine with a single reaction wheel requires gearing and is impracticable for large sizes.

These two classes comprise, first, the Parsons turbine, in which there is both action and reaction, and the expansion takes place equally in the moving and fixed blades, and secondly, those in which the whole of the expansion takes place in the fixed blades, the velocity of the steam being taken up without expansion by the moving blades. This latter class can then be sub-divided into one in which at each stage there is only a single row of moving blades as in the Rateau and Zoelly turbines, and one in which there are several rows of moving and fixed blades in each stage, which take up the velocity without any additional expansion, as in the Curtis. There are again various combinations, consisting of mixtures of one or more classes, but none of these have as yet been manufactured to any large extent. The oldest type, and one which is more in use than any other, is the Parsons, but in America the Curtis has been manufactured in large numbers, and on the Continent the Zoelly, Rateau and A.E.G., although both in America and on the Continent the Parsons has taken a leading position.

Hand in hand with the development of the steam turbine has gone the development of the various machines to be driven by it, and in this direction electrical machinery has been prominent. For many years continuous-current turbo-dynamos were looked at askance by engineers on account of commutation troubles, for it is easy to see that the ordinary constants applicable to slow speed dynamos to secure sparkless commutation are far exceeded when the speed is raised to that of turbine-driven dynamos. On this account it was early seen that some sort of compensating winding to improve the commutation and compensate for the reaction of the armature was necessary. Commutating poles alone have not proved satisfactory in practice, there being nearly always considerable difficulty in securing good commutation with them, and as a consequence commutating poles combined with compensating windings—the commutating poles giving the reactance voltage necessary for commutation, and the compensating winding compensating for armature reaction—have been adopted by many firms. But even better commutation can be secured by a compensating winding alone, in which the ampere-turns of the compensating winding exceed the ampere-turns of the armature to such an extent as to give a commutating field in the gap between the pole-pieces.

Such compensating winding is generally chiefly concentrated on the pole-pieces, and is made with from 2 to 2½ times the number of ampere-turns of the armature, in order both to compensate for leakage and to give a good commutating field; and since this method of compensating has no iron commutating pole, it has the advantage that there is no self-induction to cause time lag at sudden changes of load, and, as the field of the gap between the poles is entirely in air, it instantly responds to changes of current in the compensating winding, and thus the sparking found when there is a sudden change of load with commutating poles is avoided, and the risk of a flash-over largely reduced.

Also since there is no iron to become saturated, the commutating field is always strictly proportional to the load, and thus the trouble due to saturation causing sparking at some loads and not at others is avoided. This advantage is specially prominent where the dynamo is required to give varying voltages and to commutate at any of them without outside adjustment of the compensating windings by diverters or otherwise.

The adoption of these devices has made it possible to make turbo-dynamos of large size, and now as much as 1,500 KW. is put into a single armature, whereas before such compensating devices were adopted 500 KW. was the maximum, and even then the commutation was anything but satisfactory.

In turbo-alternators there is practically now—except for small sizes and low voltages—one standard pattern—that is, a revolving field rotating inside a stator. In the stator there is little variation in design, except in regard to the ventilating arrangements, which have to be very ample on account of the comparatively large quantity of heat to be removed from a small volume.

One point which has received great attention in recent years is the staying of the end windings of such alternators, it having been found that, owing to their great length, when a "short" took place the stresses on the winding were such as to break the insulation and cause disaster. The amount of these forces has been vastly more than was ever anticipated, and if the windings are not thoroughly stayed, such movements may be set up as to cause disaster. In the rotors there are two prominent types, the barrel and the salient pole, and much discussion has ensued as to the advantages of the one or the other. After considerable experience of both, on the whole I may say that at present I prefer the salient pole type. Ample ventilation is much easier to provide for, and improvements made in protecting and supporting the field coils of this type of rotor have resulted in a design giving great reliability with the maximum use of the space available. One improvement has been enclosing every coil in a tight sheath of sheet steel, so that any movement which may take place due to centrifugal force is between the steel sheath and the body of the rotor, and thus the insulation is protected from any rubbing which might cause it to be cut through and consequently to break down.

Voltage regulation of alternators is also of considerable importance, as owing to the inductive load required by induction motors there is a heavy demagnetising effect on the rotor, and consequent drop of voltage when the load rises. Several methods have been proposed for compounding alternators, most of them requiring a separate commutator or moving contacts altering the resistance of the exciter or main windings, but a method of compounding alternators has recently been brought out, which is being largely used with good results. In this apparatus the current supplied by the machine is made to act on the exciter field system in such a way as to reduce the leakage, artificially increased in the first instance, and so raise the voltage of the exciter, and increase the excitation of the alternator, so that any desired amount of compounding required can be obtained. This arrangement has been recently described in a paper before the Institution of Electrical Engineers.

The other applications of the steam turbine, such as driving air compressors and pumping water, have also been largely extended during the last few years, and especially prominent in this direction has been the application of turbo blowers to blast furnace work, some having been recently installed for as much as 50,000 cb. ft. of air per minute at 10 to 15 lb. pressure. In this connection it may be mentioned that a very usual size, which is for about 20,000 cb. ft., weighs about 25 tons, and that an ordinary reciprocating blower of equal capacity weighs about 450 tons, or about 18 times as much as the turbo blower.

In many parts of the country reciprocating engines are running non-condensing, and it has now been found that the exhaust steam from them is of great value. Such exhaust steam cannot be practically utilised by reciprocating engines on account of the huge size and volume of the cylinders required, but it is quite otherwise with the steam turbine, where the large volumes of the low-pressure steam are exactly what are required for the highest economy. These considerations have led to the introduction of exhaust steam turbines, taking steam at atmospheric pressure and exhausting into a condenser.

When it is remembered that there is as much power in the steam from atmospheric pressure down to 27½ in. as there is from 150 lb. down to atmospheric pressure, it is easily seen that the power of a non-condensing plant can be doubled by the addition of an exhaust steam turbine and condenser, and in cases where there is not a supply of cooling water, improvements in cooling towers have enabled them to be put up both cheaply and well.

In this connection the use of intermittent supplies of exhaust steam, such as that obtained from engines running intermittently, as in rolling-mills or winding-engines at collieries, has received a great impetus by the utilisation of thermal accumulators, in which the intermittent supply of steam is alternately condensed and re-evaporated, so that a constant flow is obtained for use in the exhaust steam turbine.

And yet another refinement has been introduced by the use of mixed-pressure turbines, in which there is a low-pressure part sufficiently large to give full power when working with exhaust steam; if the supply of this fails, a high-pressure part is brought automatically into action using steam direct from the boilers, and thus there is economical running, whether the reciprocating engines supplying the exhaust steam are working or not.

In all turbines the question of vacuum is a very important one, and various improvements have been made in condensers to enable higher vacua to be obtained. The importance of this will be seen when it is remembered that in the average steam turbine 1 in. of vacuum is equivalent to from 4 per cent. to 5 per cent. of steam consumption, or in other words, it may be taken that for every 3° F. by which the temperature due to the vacuum is reduced, a gain of steam consumption of 1 per cent. is made.

In this connection increase of circulating water is very important. A very usual amount is about 30 times, but if this is increased to 45, the gain in consumption is 4 per cent., and if increased to 65 times a further gain of 2 per cent. is made. As a rule, extra circulating water can be pumped without much difficulty, the extra power required for this being very small, but generally the temperature of the inlet to the condenser is fixed by the supply of water available.

The great desideratum then in a condenser is to maintain the temperature due to the vacuum as close as possible to that of the water leaving the condenser, as, of course, the maximum vacuum possible is that due to the temperature of this water. In ordinary condensers it is generally found that this difference amounts to 20 to 25° F., and among the various arrangements to reduce this may be mentioned dry air pumps, and also the arrangement of baffles and pumps in the "Contraflo" condenser. But a method which has been very satisfactory in practice is what is called a "vacuum augmentor," which is simply a small jet of steam drawing the air and vapour from the condenser, and delivering it through a small auxiliary condenser to an ordinary air pump, so that while there may be, say, a vacuum of only 27½ in. at the air pump, 28½ in. or 29 in. may be attained in the main condenser. Such an appliance is especially valuable when, as is often the case on board ships at sea, the system has considerable air leaks. With this arrangement the difference between the temperature of the water leaving the condenser and that due to the vacuum can be reduced to about 5 or 6° F., and this when condensing up to 12 lb. of steam per hour per square foot of condenser. As will be seen, this shows an economy in the turbine of some 6 per cent. in steam consumption above an ordinary condenser, and when it is remembered that the steam jet of the augmentor uses only about 0·6 of 1 per cent., or only one-tenth of the steam consumption gained, it is easy to see that a great benefit is derived from the use of such an arrangement.

In marine work, the development of the steam turbine also is very rapid. Two years ago the great express Cunarders *Lusitania* and *Mauretania* were only in process of construction; now they have proved themselves to be the fastest liners afloat, and it is pleasing to note that the turbines of these great ships have proved most satisfactory in service. It was a great step from the 8,000 H.P. of a cross-channel steamer, which was the largest that had been made at the time these boats were designed, to the 65,000 H.P. of these express Cunarders, and reflects great credit on the courage and foresight of the Cunard Co., and also on the various contractors, designers and engineers engaged that they have made such a great step in advance without, as many people prophesied, building another couple of Great Easterns. More mistakes have been made in going from a small to a large thing in engineering than in anything else, but the various pitfalls which awaited those responsible have been successfully avoided. It is also interesting to note that the turbines proved themselves to be very economical, a consumption of 12·77 lb. per shaft horse-power having been attained as an average of the whole voyage across the Atlantic with about 150 lb. pressure at the entrance of the turbine, and a vacuum of 28·3 in. (barometer 30 in.).

At present all cross-channel steamers in hand are being fitted with steam turbines; the whole of the ships in the Admiralty programme have also turbine engines, and everyone knows what a success the *Dreadnought* and the *Indomitable* are, they being respectively the fastest and most powerful battleship and cruiser afloat.

Hitherto, the link between the steam consumption in a marine engine, and the horse-power developed, which is represented by the indicated horse-power, has been missing in a turbine; but the introduction of the torsion meter, which measures the horse-power passing through a shaft by the amount of torsion caused, has supplied this missing link most satisfactorily. The introduction of this has been chiefly due in this country to the enterprise of Messrs. William Denny & Bros., of Dumbarton, and on the Continent to Mr. Frahm, of Messrs. Blom & Voss, of Hamburg, both of whom on slightly different lines have worked out torsion meters which have proved very satisfactory in practice. This has enabled the various losses between the power in the steam and the power required to propel the ship to be even better located than they are in the case of a reciprocating engine, where the indicated horse-power does not take into account the friction of the engine.

The steam turbine, up to the present, has been almost entirely used for ships of 17 and 18 knots and above, and, in fact, it may be generally said that about 15 knots is the lowest speed of vessel at which the turbine can satisfactorily compete with the reciprocating engine as regards economy. The difficulty of the problem lies in the fact that at low speeds the screws have to be made to revolve slowly, and at the same time the horse-power required is moderate, and thus the turbines have to be very large and heavy, and besides this the blades are so short that the loss by leakage is excessive. These considerations have led to the combination of a reciprocating engine for the high-pressure part of the range where the volume of steam is small, and where the reciprocating engine is working exactly under the conditions for the best economy, and a turbine for the low-pressure part of the range where the volume of steam is large, and where, therefore, the turbine is working under the very best conditions; such an arrangement gives advantages over either the turbine or the reciprocating engine for moderate speeds, and, in fact, it is anticipated that an extra economy of about 15 per cent. can be attained in this way. The advantages of such an arrangement were first pointed out by Mr. Parsons in 1894, but it has only recently been put into practice. Many various arrangements and combinations are possible, but that which appears to be most generally favoured is to have twin reciprocating engines each driving its own screw and exhausting into a single turbine driving a centre shaft. The reciprocating engines exhaust at about atmospheric pressure, and the turbine uses the expansion from that pressure down to the vacuum of the condenser, which may be 28 in. or 28½ in

For manœuvring or going astern the reciprocating engines are used.

At present two large Atlantic liners are being built with the above arrangement for the Atlantic service, but it may be mentioned that the destroyer *Velox*, made in 1903 by the Parsons Marine Steam Turbine Co., Ltd., for the British Admiralty, was the first ship fitted with such a combination, she having small reciprocating engines which were coupled on to the main turbines for cruising speeds, and at such speeds she proved exceedingly economical. At high speeds the reciprocating engines were disconnected from the main turbines, which were alone used.

It may be mentioned that eight years ago there were only 25,000 H.P. of marine turbines afloat; two years ago there were 800,000 H.P., and now there are over 1¾ millions completed and under construction.

In this short paper I have endeavoured to give an idea of the exceedingly rapid progress of the steam turbine, and its applications. Whether in future the progress will be equally as rapid is difficult to say, but so far as can be seen at present there is no sign of saturation in the curve of progress.

Producer Gas.

By J. Emerson Dowson, M.Inst.C.E.

(*Abstract of paper read in Section G, September 7th*, 1908.)

The first internally-fired gas producer was devised by Bischof in 1839, but little progress was made in our country until the late Sir William Siemens introduced the combined gas producer and regenerative furnace invented by his brother, Frederick Siemens, in 1857. The modern practice is to work the producer with a jet of steam at pressure which injects air, and the gas is delivered to the furnace at pressure; the cooling of the gas is thus avoided, and the hot gas flows continuously in one direction from the producer to the furnace. This type of furnace is extensively used for a great variety of purposes, and manufacturers are now fully alive to its many advantages. Its success, however, has been chiefly due to the heating of the air by the waste heat of the products of combustion, and for this useful outcome of theory and practice we are certainly indebted to the brothers Siemens. I have often been consulted by manufacturers and others who have had the idea that if they converted coal into gas, in a producer, they could burn the gas with cold air in an ordinary coal-fired furnace, and get the same high temperature as with a coal fire. This is impossible, as about 50 per cent. of the producer gas consists of nitrogen, and the nitrogen content of the products of combustion is also high; the calorific power of the gas is, therefore, low, while the heat capacity of the products is comparatively high. The flame temperature is consequently low, especially if the gas is burnt with cold air. To attain high temperatures in a furnace with producer gas at low pressure, it is not only desirable that the gas should be hot, but it is essential to heat the air, and obviously the most economical way of doing this is with the waste heat of the products of combustion. When worked in this way in a fairly large furnace it is not difficult to attain a temperature of 1,500° C. (2,730° F.), and still higher temperatures can be reached if special arrangements are made.

In connection with furnace work I should not forget to mention Dr. Mond's system of making producer gas with recovery of ammonium sulphate as a by-product. This plant can only be used on a large scale, and it needs coal containing a rather high percentage of nitrogen, as the formation of ammonia gas is an essential part of the process.

For furnaces heated by producer gas large flames are required, and the gas is burnt in large quantities; also when it is taken direct from the producer to the furnace, it retains a considerable amount of sensible heat, and the tarry vapours which accompany the gas are not condensed; they burn with the gas, and increase its calorific power and flame temperature. Many other kinds of heating work require the use of burners and small flames, and for these it is essential that the gas should be clean and of good quality. In practice it is usual for such purposes to pass the gas through water and scrubbing material, such as coke and sawdust. The gas is cooled to about the temperature of the surrounding air, and this not only means that nearly all the sensible heat which the gas carries with it from the producer is lost, but that any condensable hydrocarbons which leave the producer in the form of tarry vapours are also lost. It is therefore important that the gas itself should be of good quality, or it will not bear these losses, and will not be strong enough to burn well in small jets. When burners are used it is also important that the gas pressure at the burners should be constant, so that the heat given off by the flames may be kept uniform, or varied at will by cocks on the supply pipes. For this reason the gas must be passed through a gasholder, or its pressure must be regulated in some equally efficient manner. Sometimes a fan is used to draw gas from the gas plant, and deliver it at pressure to the burners, but this always seems to me a rather hand-to-mouth arrangement, and speaking with a considerable amount of experience, I recommend a gas-holder as better than any other device. It may be quite small, unless storage of gas is required, but it relieves the consumer of a certain amount of anxiety and trouble. In most cases it is also safer to use a gas-holder, as it ensures all the scrubbers and mains being kept full of gas a little above the atmospheric pressure; air cannot enter to form an explosive mixture. A gas-holder also shows the attendant whether a sufficiency of gas is being made, and its rise and fall can be used to regulate automatically the production of gas to suit a varying rate of consumption. It is comparatively easy to make the gas; the real difficulty is to apply it properly, and it is unfortunate that this simple fact is so often overlooked or not understood. On the other hand, some manufacturers are most keen and intelligent; and, as one pleasing instance among many, I may mention the Hoffmann Manufacturing Co., who have to temper very exactly steel balls for bearings. These balls are fed mechanically and continuously, night and day, into rotating furnaces which are heated with producer gas burnt with air at pressure; there is a registering electric pyrometer, and when once a furnace has been started with the heat required it is left without attention. The whole system works automatically, and the pyrometer chart shows how closely the required temperature is maintained. It would of course be impossible to do this with ordinary fires, and it is satisfactory to know that it is economical.

The various kinds of heating work for which producer-gas is used are too numerous to mention, but in proportion to the immense amount of heating required in the various industries thoughout the kingdom, I cannot help feeling that still more progress would have been made if manufacturers and others knew a little more about the subject technically. Often they do not seem to understand the treatment of gas or what can be done with it.

Undoubtedly the greatest development in the use of producer gas has been with gas engines, especially during the last few years. The improvements in the gas engine, in large measure, have been due to a better understanding of the thermodynamic problems involved. At first the makers of gas engines sought improvements almost exclusively in mechanical devices, and little attention was given to the behaviour of different kinds of gas under the varying conditions of temperature and pressure in the cylinder before and after each explosion.

Until the last few years the producer gas used for gas engines was generally made with a jet of steam at pressure which injected the air required, but sometimes air at pressure was forced into the producer by means of a fan or blower. The gas made in either of these ways leaves the producer at pressure, and is now generally known as "pressure" gas. In some of the early gas producers used for furnace work air was drawn into the producer by suction. As early as 1862 Dr. Jacques Arbos, of Barcelona, patented a combination of gas plant and gas engine, in which the latter drew gas direct from the producer.

I wish to emphasise the fact that the chemical reactions on which the production of gas made with steam and air depends are identical in all types of producers. On several occasions manufacturers have spoken to me as though suction gas were some new discovery; and they seemed rather surprised to learn that it was but an old friend in a new dress.

The calorific power of pressure-gas made with a jet of superheated steam is usually considerably higher than that of suction-gas. In the former the percentages of hydrogen and carbon monoxide are higher, while the percentage of nitrogen is lower; and if the gas is to be used for heating purposes in small burners, or in blow-pipes, it is better to use pressure-gas than suction-gas. But for driving gas engines, suction-gas is extensively used with excellent results, provided the engines are properly adjusted for it. Suction-gas contains a smaller percentage of combustible gas than pressure-gas usually contains; and although it requires less air for its combustion, the loss from fluid friction is greater, and for these reasons an engine worked by suction-gas develops a lower maximum power than it would with pressure-gas. This loss in maximum power is not important in a small or moderate-sized engine, but it is more serious in an engine of, say, 200 H.P. or upwards, and for a given power larger cylinders must be used for suction-gas. On the other hand, the fuel consumption in a complete pressure-gas plant with an independent boiler is higher than in a suction plant, and its heat efficiency is necessarily lower than that of a suction plant which produces its own steam. If, however, the steam for the pressure plant is raised by the sensible heat of the gas produced, as is often done, the fuel consumption and the heat efficiencies of the pressure and suction plants are alike. We may, therefore, assume that under these conditions the heat liberated by the exothermic reactions is recovered in each case to about the same extent by the endothermic reactions.

In considering the two types of plant, our general conclusions may be as follows:—A suction plant has certain practical advantages—it costs less and occupies a smaller ground space—but the gas made in it is not so strong as in the older form of pressure plant, and in some cases this advantage of the latter is important. The fuel consumption per horse-power-hour and the labour required are the same in both types of plant, provided the steam required is raised without an independent boiler. The consumption of water is the same in both types. It is also worth mentioning that where there are several engines to serve, the arrangement of the gas-pipes is greatly simplified, and their cost is proportionally reduced, when the gas can be taken from a small gas-holder instead of from several suction plants.

There is not time to deal fully with the economical and commercial aspects of the subject, but I may state generally that the results obtained are most encouraging. In large furnace work many operations are now performed with producer gas which cannot be accomplished with solid fuel, and there are many others which can be performed with either solid or gaseous fuel; with the latter the heat is not only more regular and more easily controlled, but the work done costs less, and the wear and tear of the furnace is also less. In many industrial processes where jets of gas are required, producer gas is now used instead of ordinary town gas, and the saving effected is usually from 50 to 60 per cent., including fuel, wages and repairs. In engine work there are now hundreds of thousands of horse-power working regularly and satisfactorily with producer gas. In this connection the gas-plant has come to stay, and steam power has a serious rival; in some cases the pressure type is better than the suction type, in others suction is better than pressure. Each has

its own province, and in each the consumption of anthracite is now guaranteed not to exceed 1 lb. per B.H.P.-hour under a full or three-quarter load. With low loads the consumption is a little more. For engines or for heating with small burners the best and cleanest gas is made with anthracite, as it does not yield tar; this not only simplifies and cheapens the plant, but it also reduces the cost of labour in working. Where anthracite is too dear, ordinary gas-coke can be used, provided that it is well carbonised, that it does not contain too much sulphur and that it is not mixed with pieces of coal. Non-caking bituminous coal is almost invariably used for large furnace work, and there are some plants which make gas from this fuel for engine and other work. But these plants are rather complicated and costly, and they cannot be recommended at present for small powers. They require constant attendance, whereas a plant working with anthracite or coke can be left for several hours—what is gained by using the cheaper bituminous coal for small plants is lost by the additional cost of labour, &c. It is probable that in the course of time these drawbacks will be overcome, but for the present anthracite and coke can be used, and with these the adoption of producer gas continues to advance most satisfactorily.

Experiments for Improving the Construction of Practical Standards for Electrical Measurements.

Report of the Committee to Section A.

(*Abstract.*)

The electrical measurements of certain of the fundamental units, which have been in progress for some time at the National Physical Laboratory, have been brought to a conclusion, and the results published in three papers in the *Philosophical Transactions* of the Royal Society.

From the first of these it appears that to a very high degree of accuracy the electromotive force of the Weston cadmium cell, as set up at the National Physical Laboratory, when expressed in terms of the ampere (10^{-1} C.G.S. units of current) and the international ohm, is $1{\cdot}0183_0$ at a temperature of 17° C.

The second paper deals with the preparation of the Weston cadmium cell, and contains a comparison between cells set up at the Laboratory and others constructed elsewhere, the general conclusion being that cells can be prepared by different persons in different countries which will agree in E.M.F. to 1 or 2 parts in 100,000.

In the third paper there is given an account of a comparison of some six forms of silver voltameters, and it is shown that the silver deposited by a current of 1 ampere in all these various forms is the same if proper precautions are taken, and amounts to

1·11827 milligrammes per second.

After this work was completed a comparison was made by Messrs. T. Mather and F. E. Smith, by the kindness of Mr. Trotter, between the ampere standard of the Board of Trade and the ampere as realised by the new Ayrton-Jones balance at the National Physical Laboratory. The comparison, an account of which appears in the *Proceedings* of the Royal Society, was very satisfactory.

It was found that the Board of Trade ampere will deposit silver at the rate of $1{\cdot}1179_1$ milligrammes per second, a value which is nearly identical with the number $1{\cdot}1179_4$ given by Lord Rayleigh and Mrs. Sidgwick in 1884. Indirectly the E.M.F. of the normal Weston cadmium cell was found to be $1{\cdot}0187_0$ Board of Trade volt at 17° C., the Board of Trade volt being defined as the potential difference between the terminals of a resistance of 1 Board of Trade ohm when 1 Board of Trade ampere is passing through it.

During the year the 10 mercury standards at the National Physical Laboratory have again been set up and intercompared. An account of this work appears in an Appendix by Mr. F. E. Smith, the value of the international ohm, as realised by the mean of the 10 tubes, being taken as the unit.

Except in the case of Tube P, where there is an apparent change of 3 to 4 parts in 100,000, the differences are negligible.

Mr. Smith has also compared with the mercury tubes a large series of wire standard resistances, including those made by Matthiessen and Hockin for the B.A. Committee in 1865-7, and various other old standards kindly lent to the Committee by their owners for the purpose. The general conclusion is that all the original coils except D and E, which are made of platinum, have changed appreciably since they were constructed, though since 1888, during a period of 20 years, for which the coils have been very carefully watched, the changes also in A, B, C, H, and Flat have been small. F and G have, however, in the same period changed considerably.

The mean resistance of six other platinum-silver coils, first measured in 1888, appears to have increased since that time by 14 parts in 100,000; and five more platinum-silver coils, first measured in 1894-7, have now a greater mean value by 8 parts in 100,000.

It would appear also that in many of the variable coils the changes have occurred mainly, if not entirely, at the soft-soldered joints; and, with a view of testing this, the Committee have authorised the secretary to open and examine one of the coils.

A comparison, given in the Appendix, has also been made of all the manganin resistances in the possession of the Standards Department of the Laboratory. The behaviour of the various coils is somewhat different; while some have been very constant, others appear to have changed considerably.

At the Conference on Electrical Units, held at the Reichsanstalt in 1905, it was suggested that the Jena glass 59^{III} was, from its good elastic properties, the best glass to employ for mercury resistances, and accordingly efforts have been made to get some suitable tubes. Five tubes have recently been secured, after great difficulty, which will probably do for standards, but the difficulty of drawing them is a serious obstacle to their use. A number of tubes of French glass, "verre dur," are also on order.

Progress has also been made during the year in the design of the Lorenz apparatus, to be given by the Drapers' Company, and the manufacture of the bed and the heavy metal work has been entrusted to Messrs. Armstrong, Whitworth & Co., who have kindly undertaken it. The marble cylinders required have been delivered at the National Physical Laboratory.

Preparations for the holding of an International Congress on Electrical Units in London in October next are well advanced. Specifications dealing with the international ohm, the international ampere, and the Weston cadmium cell, which have been prepared at the National Physical Laboratory after consultation with other workers, to serve as a basis of discussion at the Congress, are given in the appendix with a view of making them known.

The Committee recommend that their reports from 1862 onwards be reprinted, after careful editing, as a memorial to Lord Kelvin, and that they be reappointed for the purpose of undertaking this work and continuing their researches on the standards; that Lord Rayleigh be chairman, and Dr. R. T. Glazebrook secretary.

(*To be concluded.*)

Magnetic Observations at Falmouth Observatory.

Report of the Committee to Section A.

The mean values of the magnetic elements for the year 1907 were:—

Declination...	18° 0′·4 W.
Horizontal force	0·18799 C.G.S.
Vertical force...	0·43330 C.G.S.
Inclination	66° 32′·7 N.

The Committee are informed that the observatory at Eskdalemuir has only commenced work during the current year, so that comparative results are not yet available, while the disturbances due to electric traction in the neighbourhood of London have a natural tendency to increase. The maintenance of magnetic work at Falmouth in full efficiency has thus lost none of its importance. It is most desirable to secure this for at least another year, and the Committee ask for re-appointment, with a grant of £50.

On the Effect of Pressure on the Boiling-point of Sulphur.

By Dr. J. A. Harker and Mr. F. P. Sexton.

(*Section A.*)

Within the past few years it has been recognised that the platinum-resistance thermometer furnishes probably the most exact means we possess for temperature measurements over a very wide range. As is well known, the three fundamental fixed points on which the scale of this instrument is based are usually 0°, 100° and the boiling-point of sulphur. The latter point is used in the determination of the characteristic constant of the particular kind of wire employed in the instrument. This constant is usually called the δ of the thermometer.* The determination of this δ is made by taking the resistance of the thermometer at the temperature of sulphur-vapour, boiling freely under the prevailing atmospheric pressure. Although the value of this temperature has been determined with accuracy by several different investigators for the normal pressure, its change with pressure has been always a matter of considerable uncertainty.

The authors, therefore, made a redetermination of the effect of pressure on the boiling point, carrying the range of the experiments well outside the usual atmospheric limits. The results of the experiments were found to be closely represented by the formula:—

$$T = T_1 + \cdot0904\,(p - 760) - \cdot0000519\,(p - 760)^2$$

where T is the temperature of the vapour on the air scale at the pressure $p^{mm.}$, and T_1 the "normal" boiling point.

The following table gives the value of the departure from normal boiling point at various pressures to the nearest ·01° C.

Pressure.	$T - t_1$, degrees C.	Difference for 1 millimetre.
740	− 1·83	
		·092
750	− 0·91	
		·091
760	− 0·00	
		·090
770	+ 0·90	
		·089
780	+ 1·79	

* This is defined by the relation—

$$d = T - p\,t = \delta\left[\left(\frac{T}{100}\right)^2 - \frac{T}{100}\right]$$

where d is the difference between the "platinum temperature $p\,t$ and the "air temperature" T.

It will be seen that the effect decreases somewhat rapidly with rise of pressure, and is much greater than the value usually employed—viz., ·082 mm. per degree, deduced from Regnault's observations.

If, for example, the value of δ be calculated for a thermometer, whose true $\delta = 1{\cdot}500$ from observations made at 730 mm., the temperature of the vapour at this pressure being obtained by use of Regnault's values for the divergence from the normal temperature—the error in the δ thus obtained would be ·018. This would lead to the scale of the instrument in use being in error by reading ·36° C. high at 500° C. and 1·6° C. at 1,000° C., quantities of importance for work of even moderate precision.

BUSINESS NOTES.

Bankruptcy Proceedings.—The affairs of JOHN HOPE CALLCOTT, lately carrying on business as an electrical engineer in partnership at Clayton Works, Little East Place, Kennington, came before Mr. Registrar Hope on Tuesday at the London Bankruptcy Court, upon the debtor's application for the Court's sanction to a scheme recently entertained by the creditors. According to the report of Mr. Daniel Williams, assistant Official Receiver, the debtor failed last May, with ranking liabilities £1,953, and assets "a bank balance of £5 12s. 2d." For many years he was in the employ of the Government of the Straits Settlement as a civil engineer, and he retired in 1902 with a pension of £720 per annum. In April, 1907, he took a workshop at Dalston Road, Kingsland, N., and in conjunction with another person, who afterwards joined him in partnership, commenced business as electrical engineers, shortly afterwards removing to Clayton Works, Kennington, which premises he fitted up at a cost of £350. In March, 1908, during the debtor's absence by reason of illness, the partner removed the whole of the machinery, and the debtor had been unable to trace his whereabouts or to ascertain what had become of the property. The failure was attributed, among other causes, to loss sustained in connection with that business. The scheme provided for the setting aside of £25 per month from the debtor's pension until the creditors had received a composition of 10s. in the £. The Assistant Receiver reported as offences against the Act, (1) insufficiency of assets to pay 10s. in the £ to the creditors, and (2) a previous arrangement with creditors. He also reported that the scheme was reasonable, and calculated to benefit the general body of creditors. The Court adopted that view and approved the scheme.

A receiving order has been made at the Manchester County Court on a creditor's petition against GEORGE HARRY SMITH, electrical engineer, of 15, Ashley Road, Altrincham. The first meeting will be held on September 16th, at 11 a.m., at the Official Receiver's offices, Byrom Street, Manchester, and the public examination on September 18th, at 10 a.m., at the Court House, Quay Street, Manchester.

EMPIRE ELECTRIC LIGHT AND POWER CO., LTD., Arundel Street, W.C.—A first dividend of 15s. in the £ was announced in the *London Gazette* of September 4th.

Liquidations.—In *re* PETER PILKINGTON, LTD.—The report of the liquidator, Mr. J. Todd, shows that cash has been received from the purchasers to pay all the creditors 10s. in the £, and part of the creditors 5s. in the £ (the remaining creditors taking 10s. in shares in lieu of cash), and to defray the expenses of liquidation—in all £5,892 7s. The liquidator gives notice of application to the Board of Trade for his release.

Electric Grinders.—Messrs. Geo. Robson & Co. have filled a third repeat order for their patent electric grinder from Messrs. Edgar Allen & Co., Imperial Steel Works, Sheffield, and have also received an order for one of these machines from Messrs. Thos. Firth & Sons, Norfolk Works, Sheffield.

Catalogues and Lists.—THE ARMORDUCT MANUFACTURING CO., LTD., Farringdon Avenue, E.C.—Illustrated booklet describing the "Witton Grip" for securing metallic continuity in conduit work, and including a Faraday House report on its efficiency. All the ordinary fittings of the company have been adapted for use with this grip, and are listed. Many installations have already been carried out with the Witton grip.

MESSRS. DAVIS & TIMMINS, LTD., York Road, King's Cross, N.—Price list of Whitworth hexagon brass nuts, finished.

THE SANTONI ARC LAMP AND ENGINEERING CO., LTD., 11, Farringdon Avenue, E.C.—Price list of "Santoni" intense flame lamps, describing the "Santoni Luxrae," pattern 1908, the "Perl" enclosed arc lamps, transformers for arc and metallic-filament lamps, and a patent automatic transformer switch for the latter—all of British manufacture. The firm also makes a speciality of armature rewinding and repairs of all kinds.

HOLOPHANE CO., 227-229, Fulton Street, New York.—"Holophane" for August, specially relating to the Holophane D'Olier metal reflectors for shop and factory lighting, and containing other interesting items.

MESSRS. NEVILLE, WILLIAMS & CO., 11 and 13, Southwark Street, S.E.—Catalogue No. 5, describing the Howard miniature and candelabra lamps, for a wide range of voltages and candle-powers. Both carbon and metallic filaments are listed. Surgical, telephone and automobile lamps, and a variety of small accessories, are also shown.

MESSRS. MARPLES, LEACH & CO., LTD., Adnil Building, Artillery Lane, E.C.—Leaflet relating to the "Adnil" electric hooter, which is suitable for use in mines, on railways, factories, motor-cars, and ships. While consuming very little power (about 4 watts while sounding), this hooter gives a loud, clear signal, audible at a distance of one mile, and is made for all voltages from 8 to 220.

MESSRS. SIEMENS BROS. & CO., LTD., London.—August supplement to catalogue No. 502, giving full information and prices of protecting tubes for thermo-electrical pyrometers, including Marquardt and quartz tubes, &c.; also leaflet No. 502 IX describing Siemens pyrometers, of the calorimeter, electrical and optical types, and reprint No. 508A, on electrical testing instruments.

THE GENERAL ELECTRIC CO., LTD., 71, Queen Victoria Street, E.C.—New "Heating" catalogue, brought up to date for the approaching (or current?) winter. Particulars are given of the Archer system of electric heating, many patterns of radiators being illustrated; the Archer "Elevectors," for heating by convection, also occupy many pages. Electric cooking apparatus of all kinds are listed, and the variety of utensils now available appears to indicate that the public are learning to appreciate the convenience, cleanliness and efficiency of cooking by electricity. Electric irons and similar apparatus figure largely in the catalogue.

THE ELECTRICAL CO., LTD., 121-125, Charing Cross Road, W.C.—Leaflet No. 288, on Photographic Arc Lamps, showing various patterns suitable for blue printing, engraving and studio work. Enclosed and open arcs are used. Both D.C. and A.C. accessories are also listed.

MESSRS. W. BARNS & SON, Globe Works, Queensland Road, Holloway, N.—Catalogue of perforated metals, in numerous patterns and thicknesses; woven wirework of all kinds; name plates and stencils; and a variety of miscellaneous patterns of bars, mouldings, &c.

MESSRS. GEIPEL & CO., Vulcan Works, 72A, St. Thomas Street, S.E.—Pamphlet describing the Benedict nickel seamless tubing, for which they are agents. The colour of the tubing has been further improved, so as to resemble silver plating right through, and the price has been reduced.

MESSRS. D. HARPER & CO., 258, Holloway Road, N.—Price list of calendars, pocket-books and novelties for advertising purposes, with special reference to the Manchester Exhibition.

MESSRS. LACY-HULBERT & CO., LTD., 91, Victoria Street, S.W.—Catalogue No. 3 of "Boreas" patent air-compressors for low and high pressures, driven by electricity or steam, in a variety of patterns and sizes, fixed and portable. These compressors are made for power station use, railway brakes, factories and mines, motor-cars, &c. "Boreas" vacuum pumps for many purposes, pneumatic drills and grinders, and a number of accessories, are also listed.

J. CONWAY PRICE, 151, Fleet Steet, E.C.—Leaflet relating to his advertising novelties and special designs for the Manchester Exhibition.

Book Notices.—"Journal of the Institution of Electrical Engineers." Vol. 41, No. 191; August, 1908. London: E. and F. N. Spon, or the Institution. Price 5s.—This part contains "New Alternate-Current Instruments," by W. E. Sumpner and J. W. Record; "High-Speed Electrical Machinery," by G. Stoney and A. H. Law; "Electricity Supply Prospects and Charges," by H. W. Handcock and A. H. Dykes; "The Life and Work of Lord Kelvin," by Prof. S. P. Thompson; "Electrolytic Corrosion," by Prof. W. W. H. Gee; "Heating of Ventilated and Closed Motors," by W. Hartnell; and "Electric Street Lighting," by W. F. Long. A communication by Sir Oliver Lodge and B. Davies "On the Measurement of Large Inductances containing Iron," and one by Dr. H. Bohle on the "Magnetic Reluctance of Air Joints in Transformer Iron," are also included.

Supplement to Ross's Coder for Codifying Figure or Letter Cypher. Eden Fisher & Co.—The compiler, Mr. C. Edmonstone Ross, invites attention to the fact that the syllable system is not applicable to inland telegrams in the United Kingdom, as the local rules have not been assimilated with the new international rules regarding the use of artificial code words. The Government of India have, he states at his suggestion, followed the lead of the International Telegraph Conference in this matter. The compiler states that the supplement is complete in itself, and it is not necessary to use it in conjunction with his coder, the main improvements being (1) Tabular rearrangement, which greatly simplifies and facilitates reference; and (2) Elimination of certain syllables in order to prevent possible ambiguities in signalling. The author's ambition is to see the syllable system (either his own or a better one) more or less universally adopted by private individuals, because it will bring the telegraph, and more especially the cable for "over-the-sea" messages, within the reach of many who are at present, on the score of expense, debarred from these benefits, and by code users, because it will not only reduce their cable and telegraphic charges by 50 per cent. but will, at the same time, ensure accuracy in transmission. In stating his ambitions, the author does not appear to be aware that private individuals have many more facilities for coding their messages than they used to have, for so-called social codes exist—we might mention those of the Eastern Telegraph Co. and the Royal Mail Steamship Co., and there are many others—by means of which they are able to send long sentences in one word and with less trouble than is entailed by the use of tables. There is really only one remedy to place telegraphic communication and facilities at the disposal of all, and that is the lowering of rates for this class of work especially, and once this has been done there will be little need of codes or tables. There are also others who have the same aim in view as Mr. Ross, whose codes and methods of coding are exceedingly ingenious, but in our mind quite unsuitable for the

average private individual, who would be very liable to make mistakes in the compilation of words with the aid of tables. Again, several conversant with the working of telegraphs have in codes or cyphers eliminated to the greatest extent all risk of error by omitting from their publications all letters the telegraphic signals of which are near to those of another, and in this connection we may mention that we have on several occasions made reference in our columns to the codes compiled by Mr. J. Nicolson, late telegraph superintendent of the Western Telegraphic Co., whose work in this respect has been admirable. As the *Indian and Eastern Engineer* states, "figure mazes have no terrors for Mr. Ross," whose system and tables are very ingenious, and to those firms who wish to employ two codes and have the time, it would perhaps prove useful and save them some expense.

"L'Azione del Vento sulle Linee Aeree." By G. Rebora. Milan: Rebeschini di Turati. Extract from the *Proceedings* of the Italian Electrotechnical Association.

"Calendar, 1908-9, of the Glasgow and West of Scotland Technical College, Glasgow," from the College.

"Proceedings of the American Institute of Electrical Engineers." Vol. 27, No. 7; July, 1908. New York: The Institute. Price 50 c.

"Cranes: Their Construction, Mechanical Equipment and Working." By Anton Böttcher. Translated and supplemented by A. Tolhausen. London: Constable & Co. 1908. Price 42s. net.

"Statistics of Public Education in England and Wales, 1906-7-8"; issued by the Board of Education. Part I: "Educational Statistics." London: Wyman & Sons, Ltd. Price 2s. 3d.

"Mineral Waxes." By R. Gregorius. Translated from the German by C. Salter. London: Scott, Greenwood & Son. 1908. Price 6s. net.

"Science Abstracts," Sections A and B. Vol. 11, Part 8. August, 1908. London: E. and F. N. Spon. Price 1s. 6d. each part.

LIGHTING and POWER NOTES.

Accrington.—The L.G.B. has sanctioned the borrowing of £7,500 for the purposes of the electricity undertaking in this borough.

Belfast.—The L.G.B. auditor has made several surcharges, those affecting the Electricity Committee being the subscriptions to the Municipal Electrical Association and the expenses of delegates attending their conferences. The Finance Committee has appealed against these surcharges.

Canada.—The Great Falls Power Co., through its solicitor, has offered to sell 30,000 H.P. or more to the Manitoba Government at $12 per annum per H.P., measured at the power station, which would be situated on the Winnipeg River. The contract would be for a term of 40 years, and it is proposed that the Government should distribute the power over its telephone pole lines throughout the province. The price is similar to that agreed on by the Ontario Government for Niagara Falls power.

Cheltenham.—On a proposal to expend £700 on additional plant at the electricity works, the question of disposing of the supply undertaking came up, and an amendment that the recommendation should be referred back was moved, but unsuccessfully.

Clacton-on-Sea.—The U.D.C. has decided to endeavour to obtain a day load by supplying large consumers during the daytime and after 11 p.m., for motive power, at 2½d. per unit.

Colchester.—The T.C. has agreed to the laying of a H.T. feeder to Hythe Quay at a cost of £750, in order to supply Messrs. Spottiswoode & Co.'s works and others with energy.

Darwen.—The T.C. has agreed to the following charges from October 1st, to consumers of electricity for power purposes for the day load only:—The first 500 units per quarter, 2d. per unit; the second 500 units per quarter, 1½d. per unit; above, 1d. per unit.

Dover.—The T.C. has approved of the extension of the E.L. mains to the growing district of St. Margarets, where there are 58 probable consumers representing 920 lamps. A loan of £3,000 for this purpose is to be applied for.

Fareham.—A L.G.B. inquiry was held on September 2nd into the application of the U.D.C. to borrow £10,000 for electric lighting purposes. The scheme was based on an equated period of 22 years, but the inspector pointed out that the L.G.B. would not sanction an equipment loan for a longer period than 15 years; he also strongly deprecated the bringing forward of any outstanding liability on the old plant as part of the capital of the new scheme.

Felixstowe.—As the only way out of the electric lighting difficulty, the Committee recommends the Council to buy out the present company on or before June 30th, 1909, and in the meantime to build a steam generating plant near the sewage outfall works or other approved site. The company would remove its four-cylinder gas engine and producer plant, which has been the chief cause of nuisance, and the Council would utilise the buildings as a distributing station. The company has offered to accept £8,000 for all its rights under agreement, and overhead mains, provided the offer is made before the end of September. The Council considered the matter at some length and decided to bring the report up again at a special meeting on the 16th inst.

Greenock.—The torpedo factory at Battery Point, Greenock, will be supplied with H.T. alternating current at 3,300 volts pressure by the T.C.; the total length of cable will be approximately 4,200 yards, and the cost is estimated at £1,750. The pressure will be reduced at the torpedo factory to 500 volts by transformers and rotary converters, the latter being supplied by the Admiralty.

Guildford.—Eight arc lamps are to be erected in the town by the Guildford Electric Light Co., the cost of erection being £50, which amount is to be defrayed by 20 local tradesmen.

Hastings.—At the meeting of the T.C. on Friday last the motion to increase the price of energy or to so adjust the charges that the revenue of the electricity department shall be increased by not less than £3,000, was rejected by 20 votes to 8.

Herne Bay.—The U.D.C. has decided to apply for a prov. order for electric lighting.

Longton.—In order to induce tradesmen to use electricity for outside lighting, the T.C. has decided to supply current for that purpose at a flat rate of 4½d. per unit, less 5 per cent. discount.

London.—The inquest on the victims of the recent balloon explosion at the Franco-British Exhibition resulted in verdict blaming the use of an electric fan for charging purposes, it having been suggested that a spark caused the hydrogen mixture to ignite.

KENSINGTON.—The town clerk is communicating with the Metropolitan Councils relative to the action of the district auditor in taking exception to certain expenditure incurred by officials of the Kensington Council in attending technical conferences, explaining that whilst the L.G.B. had allowed the expenditure in pursuance of the Local Authorities (Expenses) Act, 1887, the Board had intimated that it will not undertake to sanction similar expenditure in the future. The Kensington Council considers that it is highly desirable that the Metropolitan Borough Councils should have the power to incur reasonable expenditure in respect of the attendance of members and officials at conferences having a bearing upon their duties, and a communication has been addressed to the L.C.C. asking it to insert in its next General Powers Bill a clause giving this power to Borough Councils in the metropolis.

Maidstone.—A L.G.B. inquiry was held on September 1st into the application of the T.C. for a loan of £20,100 for electricity purposes, made up as follows:—Excess expenditure, £5,559; new works, £9,091; mains, £4,000; house services, £1,450.

Marlow.—Messrs. T. Wethered & Sons, of the Marlow Brewery, having been asked to supply electricity to houses in the town, have asked the U.D.C. for permission to lay a cable under the highway. The Council has asked for further information before arriving at any decision.

Oldbury.—The U.D.C. has completed negotiations for transferring the E.L. order to the Birmingham and Midland Tramway Co., which is now empowered to supply energy to private persons.

Oldham.—The T.C. has applied to the L.G.B. for a loan of £8,000 for mains, £1,250 for meters, and £1,000 for services for three years.

Rochdale.—The application of the Tramways Committee for a reduction in the price of energy for tramway traction, has been considered by the Electricity Committee, and refused. The Electricity Committee has also considered the question of the charges for electricity for lighting, and decided to adopt a sliding scale of discounts, ranging from 2½ to 10 per cent.

Russia.—La Société Générale d'Electricité, of St. Petersburg, has declared a dividend of 4 per cent. for the last financial year.

Stafford.—In a report on the mines in this district, it is stated that 49 coal-cutters are in use, 17 being electrically, and 32 compressed-air driven. It is interesting to note that the former turned out 286,507 tons of coal, as against only 130,225 tons by compressed air. The amount of machine-cut coal was only 416,723 tons, out of a total of 16,168,000.

Thrybergh.—The P.C. on September 1st considered an E.L. scheme for public lighting submitted by Mr. J. Elce, whereby the Dalton Main Colliery Co. offered to light the public streets. The terms offered were considered to be satisfactory, and the opinion was expressed that it would be desirable if the supply of energy was available for private consumers. It was decided to lay this matter before the company before coming to a final decision.

Wigan.—An offer made by Messrs. Sharrock & Gaskell to take a supply of energy for power purposes at ½d. per unit for their collieries, was recently accepted by the T.C. after a lengthy discussion. The agreement was fixed for 12 months on trial.

ELECTRICITY IN A GERMAN IRON AND STEEL WORKS.

[BY OUR BERLIN CORRESPONDENT.]

The development of the iron and steel works of Rasselstein, Germany, is intimately connected with the history of the German iron industry. In fact, as far back as in 1655 there is said to have existed an iron works at the same place, which after repeated reconstruction and extension developed into one of the most extensive iron and steel works of the country, fine sheet metal being the most important manufacture.

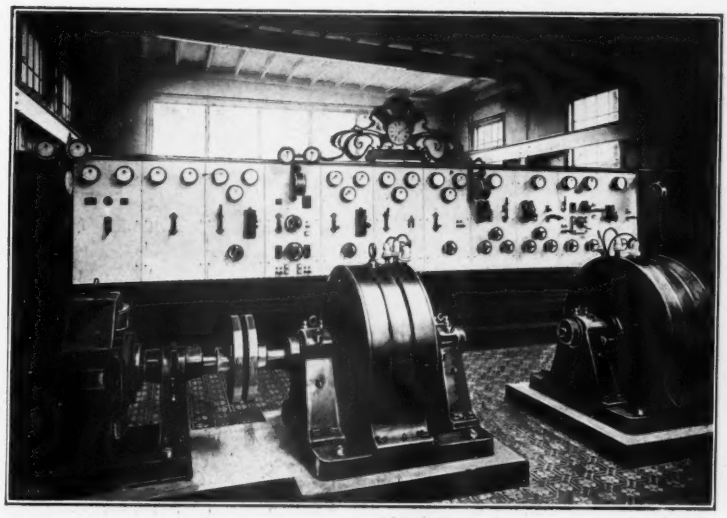


Fig. 1.—The Main Switchboard.

As electricity is now mainly used in operating this concern, it may be considered as typical of the best German practice in this connection, and is well worth a description.

Electrical energy is generated in a power station (figs. 1 and 2), situated beside a steel works recently erected, also at two, upper and lower, turbine power houses. Owing to the considerable distances between those power houses, H.T. alternating current at 5,000 volts pressure was chosen for transmission purposes, being transformed down to 500 volts pressure to operate the small size motors. The power station of the new steel works, which principally operates the motors in the latter, and in the mill-bar rolling mill, has been designed for alternating current at the lower pressure, 500 volts, though that power station can be connected to the others through the intermediary of transformers. Three motors of 400 H.P. each in the finishing sheet metal rolling mill, are at present operated directly by H.T. current.

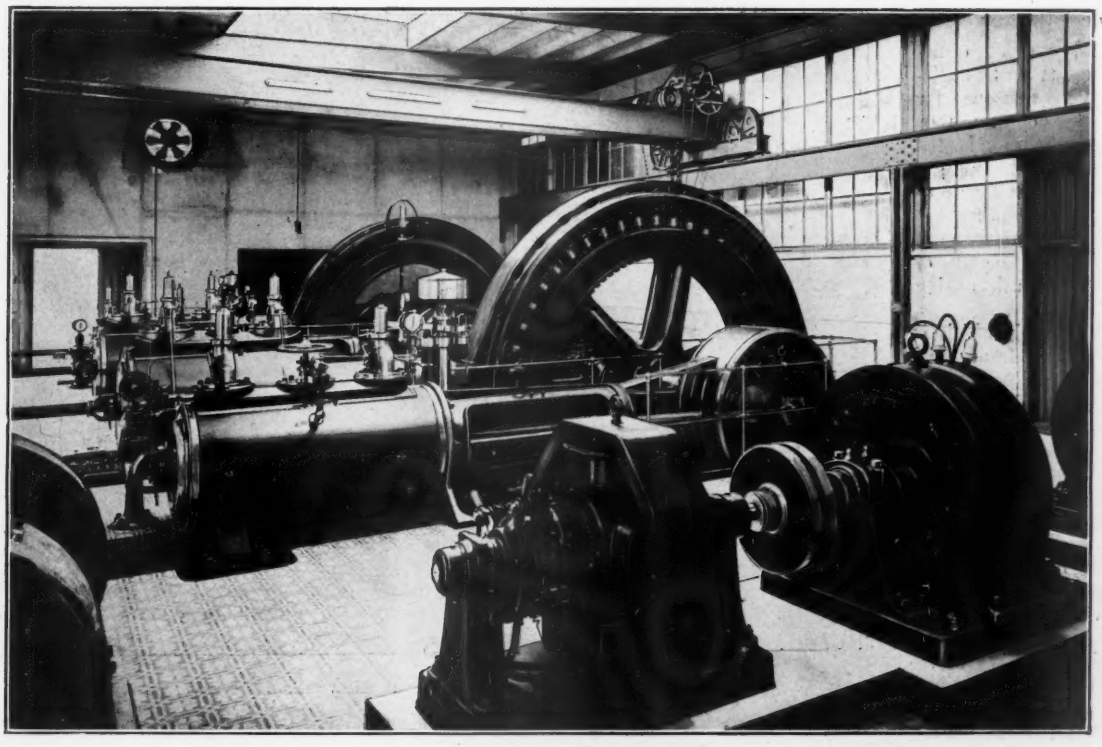


Fig. 2.—Interior of the Power House, New Steel Works, Rasselstein.

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The following machines have been installed in the various power houses :—

Two generators of 410-K.V.A. each, at 510 volts pressure; speed, 125 R.P.M ; direct coupled to horizontal double-cylinder twin steam engines, constructed by Sulzer Bros.

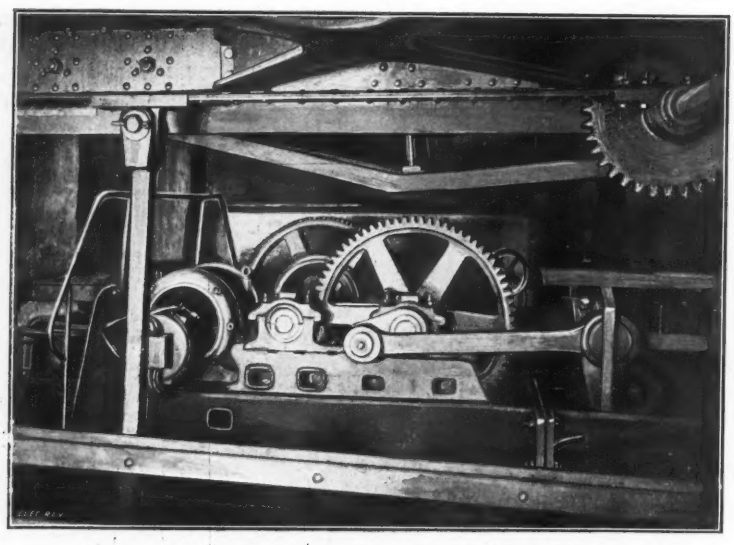

Fig. 3.—Electrical Drive for the Tilting Table.

One generator of 1,080-K.V.A. capacity, at 5,100 volts pressure and 83 R.P.M., which is direct coupled to a horizontal steam engine supplied by Främbs & Freudenberg.

Two generators of 300-K.V.A. each, at 5,100 volts pressure, 300 R.P.M., direct coupled to two hydraulic turbines constructed by F. M. Voith.

Two generators of 210-K.V.A. each, at 15,100 volts pressure, and 300 R.P.M., direct coupled to two hydraulic turbines supplied by the same constructor.

The recently built steel works comprise two Siemens-Martin furnaces for charges of 20 tons each, which are heated with producer gas generated in four producers, each furnace being able to turn out 200 steel ingots of 500 kg. each during 24 hours.

The coal, which is supplied from the Rhur district, is usually dumped directly from the trucks on to the platform of the producer house, though an electrically-driven crane has been provided to handle the coal from the stores situated on the ground level.

An electrically-driven monkey serves to crush the coarse iron and steel scraps for steel production and use in the iron foundry. Pig-iron and scrap are charged together into tray-shaped vessels of 600 to 1,000 kg. capacity, three of which are placed on a truck and lifted by one or other of two electric elevators up to the furnace platform. The platform is controlled by a charging crane of 1,200 kg. capacity, which introduces the iron-loaded trays into the furnace, and there discharges them. In addition to a travelling outrigger, the crane is fitted with an auxiliary crab, special lifting and travelling motors, and seven electric motors for driving capstans, controlled from a driver's cage fitted to the outriggers. For the crab travelling, as well as for the lifting and lowering of the outriggers, motors of 16 H.P. each are provided, and for the transverse travelling and tray slewing, as well as for the lifting gear of the auxiliary crab, motors of 10 H.P. each, while motors of 4 H.P. effect the arm-slewing and crab travelling motions.

Before tapping the furnaces, some samples are derived from each charge, which are forged on an electrically-driven pneumatic hammer; this is operated by a 6-H.P. motor, which gives a maximum of 150 strokes per minute, with a lift of 24 cm.

After completing the charge the furnace is tapped, and the liquid steel is poured out into a ladle suspended from a 4-motor foundry crane of 40 tons capacity, with an auxiliary winch of 5 tons (fig. 4). For the crane-travelling and ladle-lifting motions, motors of 42 H.P. have been provided, for the ladle-tilting an auxiliary lifting motor of 5 H.P., and for the crab-travelling a motor of 11 H.P. The liquid steel is poured into chills, which give ingots of 500 kg. average weight. After the steel in the chills has become solidified, the chills are removed from the ingots by a three-motor tongs crane of 5 tons capacity (fig. 5), which places the ingots in groups of three on small trucks for conveyance to the rolling mill. The tongs crane is provided with two

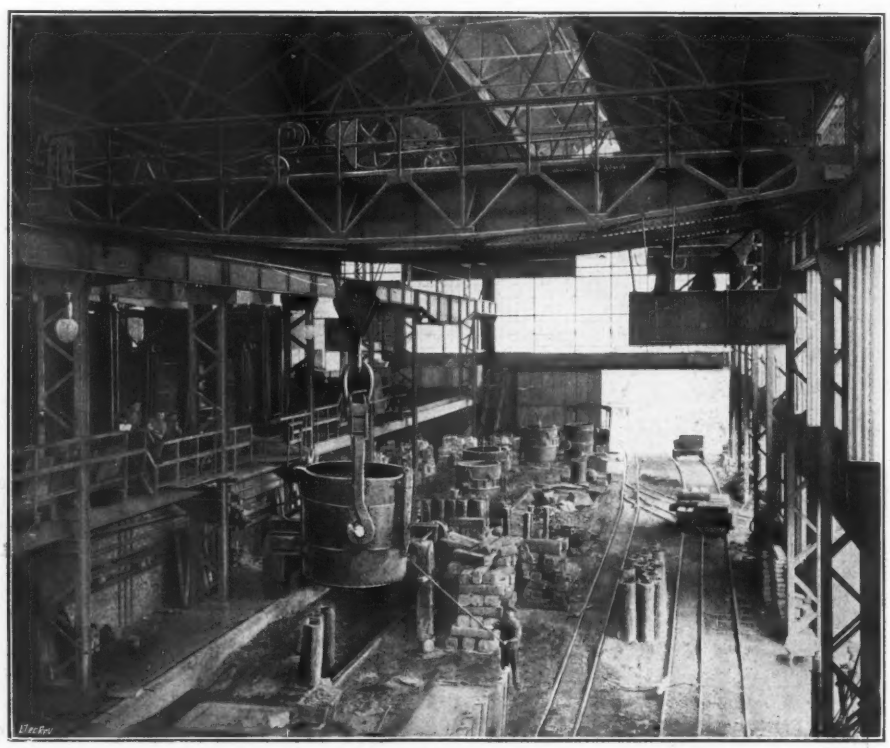

Fig. 4.—40-ton Foundry Crane, New Steel Works.

motors of 30 H.P. each, for the crane travelling gear and lifting gear respectively, in addition to an 11-H.P. motor for the crab travelling. The driver's cage of the crane is arranged on the travelling tongs support, and the gap of the tongs is adjusted by hand from the driver's cage.

The ingots introduced into the rolling mill are taken in

front of one or other of the two rolling furnaces, in which they are placed by electrically operated ingot-setting devices. A 30-H.P. reversible motor is provided for operating each of these ingot-setting machines. From the rolling furnaces, one of which—like the Siemens-Martin furnace—is heated with producer gas, whereas the other is stoked with coal, the ingots are removed by a discharging crane, and placed on the feeding train of the mill-bar rolling mill. The latter is made up of two treble-roller frames, with rollers 700 mm. in dia., and a polishing frame, and is operated by a compound steam engine.

From the feeding train the ingot is conveyed to the working roller train, which carries it to the first rolling frame. Behind the latter there is an electrically operated parallel lifting table, which raises the ingot and introduces it over electrically operated idlers into the second groove between the upper and middle rollers, whence the ingot is dropped down on the working roller train again, the operation being repeated over and over, according to the number of strokes performed in the first rolling frame. From the latter the elongated bar is conveyed to the second frame. Behind the second frame is an electrically-driven tilting table (figs. 3 and 9). The rolled-out bar then passes to the polishing frame, in order to be there passed through a working roller train between polishing rollers. At the back of the polishing frame is an extensive water bath, into which the bar slides. After a short time—during which the surface is rapidly cooled by the water, thus freeing it from any adhering impurities—the bar is lifted from the bath and placed on one or other of the two roller trains arranged beside it. Two roller trains behind the polishing frame convey the bars to two pairs of shears for cutting. Both pairs of shears are operated by a 70-H.P. motor, and perform a maximum of 33 strokes per minute. The cut parts are dropped into the pivoted cage of an elevator, in order to be lifted and automatically charged into trucks, which finally take the bars into the sheet-metal rolling mill, to be rolled out to fine sheet metal.

The electrically-operated machines of the bar-rolling mill are controlled from three switchboards, situated in front of the three frames of the rolling mill, behind the first and second frames, and close to the shears and elevators respectively.

The following motors are controlled from the first switchboard:—A 30-H.P. roller-train motor, for the feeding and working trains, in front of the first rolling frame; a 30-H.P. truck motor, for the truck running between the first and second rolling frames; a 30-H.P. roller-train motor, for the working roller-train, in front of the second rolling frame; a 30-H.P. truck motor for the truck running between the second roller frame and polishing frame; a 30-H.P. roller-train motor for the roller train in front of the polishing frame.

From the second switchboard there are controlled:—A 30-H.P. lifting motor for the parallel lifting table, behind the first rolling frame; a 30-H.P. roller-train for the idlers of that table; a 30-H.P. lifting motor for the tilting table behind the second rolling frame; a 30-H.P. roller-train motor for the idlers of the tilting table; two 15-H.P. motors for the two bracket sets of the water bath.

From the third switchboard there are controlled:—Two 15-H.P. roller-train motors for the transporting roller-trains beside the water bath; a 70-H.P. motor for operating the two pairs of shears; two 15-H.P. lifting motors for the two charging elevators; a 20-H.P. motor for the monkey serving to crush the pig-iron.

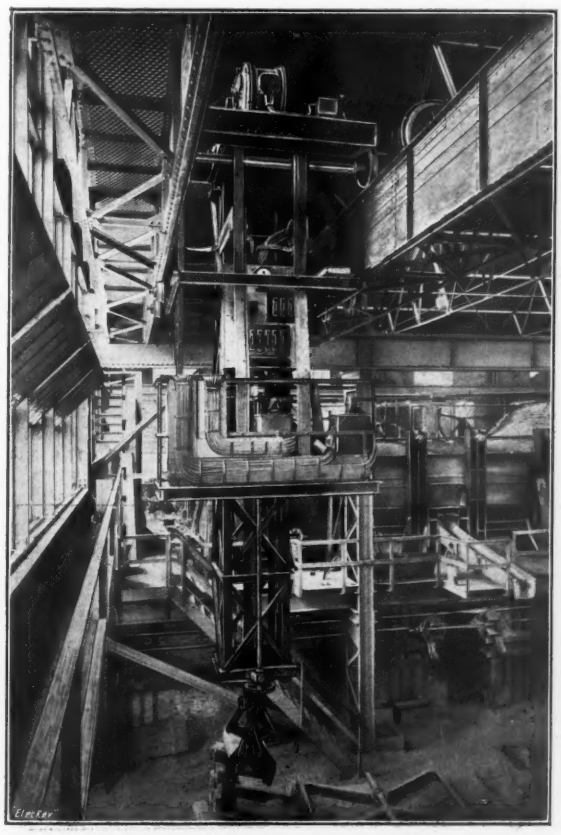

Fig. 5.—Electrically-Operated 5-ton Tongs Crane.

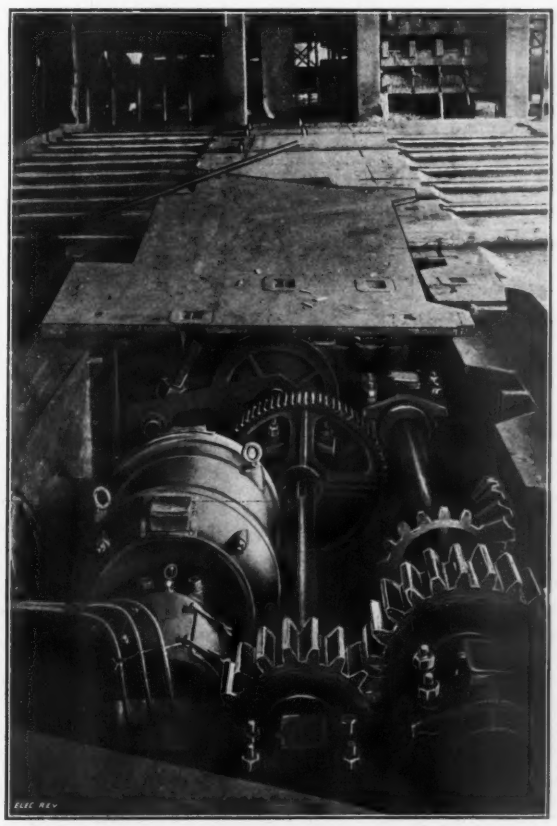

Fig. 6.—Driving Gear, Roller Train.

Care was taken as far as possible to reduce the number of types of motors used for these purposes, thus reducing the spare parts to a minimum, and allowing of motors being exchanged and fitted up again at some other place.

The advantages just mentioned more than counterbalance the slight saving in the first cost possible by choosing the type best adapted to each special case.

The motors used to operate the cranes, as well as the roller trains, trucks, and lifting tables are of the enclosed type (fig. 8). The operation of the roller train requires the several auxiliary machines perfectly to adapt themselves to the rolling process. The motors are stopped, re-started, and reversed very frequently (up to 15 times per minute) in performing the various operations entailed by the rolling of the bars, and the heavy bulk of the roller trains, lifting tables, &c., has to be frequently accelerated and retarded. In fact, the motors used are able to yield a torque three times as great as their normal duty, during intermittent operation.

Similar requirements are made in connection with the controllers used for the motors. The controllers intended for the operation of the roller trains and lifting tables

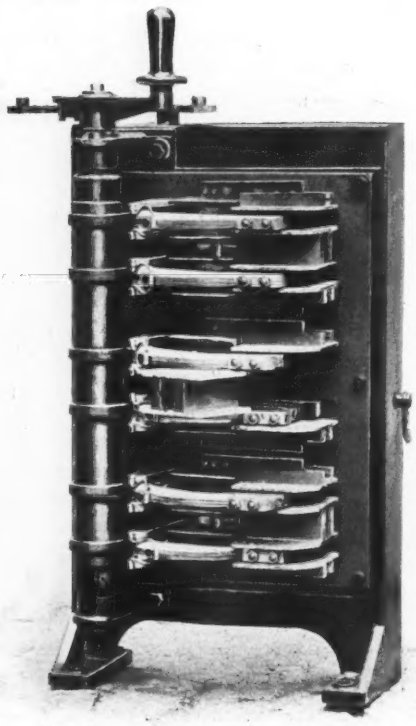

Fig. 7.—Double-Stage Reversing Controller, with Carbon Contacts.

(fig. 7) are provided with carbon contacts, metal contacts being subject to too much wear in the case of heavy duties. The contacts used in connection with these controllers are made up of a fixed (but readily exchanged) copper carbon of high conductivity, and a movable hammer provided with an interchangeable copper piece. The motion of these contact hammers (all of which are identical) is effected by a vertical cam shaft, operated by a hand wheel. The whole mechanism is readily adjustable, and is provided with a housing easy to remove. The rheostat is arranged separately on the switchboard.

Armoured cables are used in connecting up the motors used in the rolling mill, as well as for supplying energy to the contact wires of the cranes, while well-protected, rubber-insulated conductors are used on the cranes themselves.

The electrical machinery installed in the various power stations, and by far the larger part of that used in the steel works was supplied by Messrs. Siemens-Schuckert & Co., to whose courtesy we are indebted for the illustrations given.

Threatened Collapse of the Aluminium Convention.—The conditions in the aluminium industry, as was mentioned in this journal some time ago, have become less satisfactory to producers in the past year or two in consequence of the increase in competition and the fall in prices, although the latter circumstance has naturally been of advantage to consumers. At the April meeting of the Aluminium Industry Co., of Neuhausen, it was stated on behalf of the directors that the crisis in the United States had largely restricted the consumption of the metal. The production had greatly increased, and as a result the competitive conditions had become materially aggravated. It was added that the company had therefore augmented the amount carried forward to the new financial year on the ground that 1908 stood in the area of competition, that the company would have to fight, and that money was needed for the purpose. The *Neue Zurcher Zeitung* now announces that the existing community of interests (the international convention) will be abolished at an early date with the object of offering keener rivalry to the new competitors. It may be remembered that a firm association of all the then existing aluminium producers was formed in November, 1901, but as the objects of the convention have now been crossed by outsiders, it is proposed to abolish the agreement. The result of this step will naturally be to accentuate the competition, and a further depression in prices seems possible. On the other hand, it is considered that the collapse of the convention will yield certain advantages to the works individually, by reason of the greater freedom of action which they will secure, especially to the old-established producers, who may thereby find partial compensation for the disadvantages accruing from the break up of the agreement.

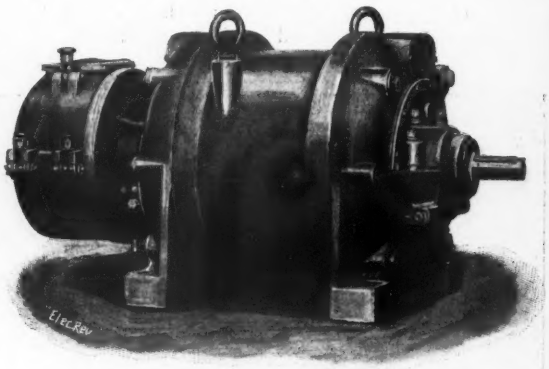

Fig. 8.—Type of Motor Employed for Driving Roller Train and Lifting Tables.

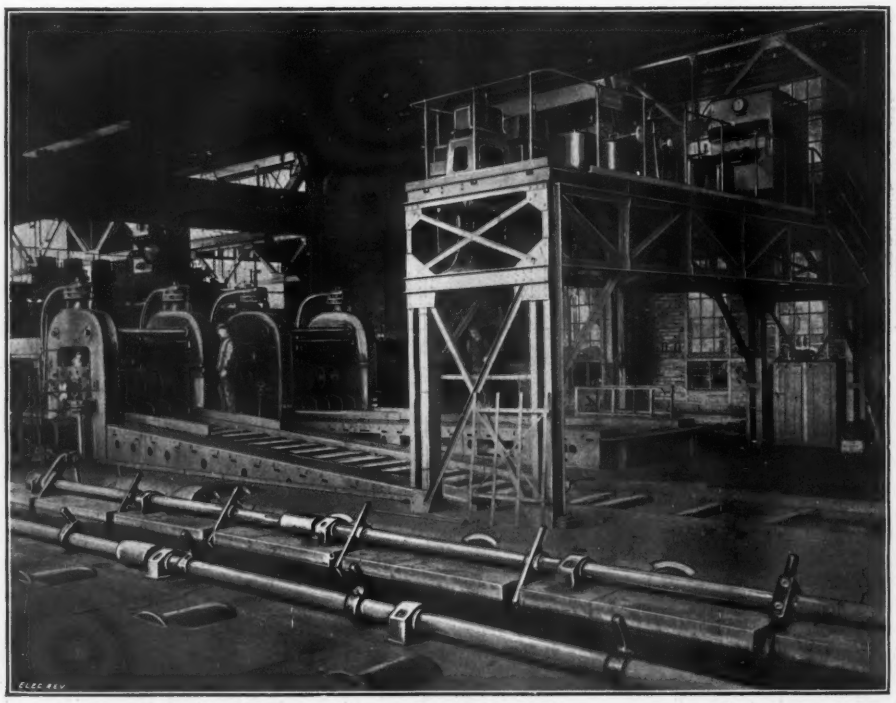

Fig. 9.—Mill Bar Rolling Mill, showing Switch Platform and Lifting and Tilting Tables

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TRAMWAY and RAILWAY NOTES.

Birmingham.—A satisfactory trial has been made of a car fitted with the Maley patent brake, described in our issue of November 29th, 1907. The results will be reported to the Tramways Committee in due course, and it is stated that the new brake may be adopted on certain local routes.

Bradford.—The annual report of Mr. C. J. Spencer, the tramways manager, shows that this undertaking, in spite of its extensive route mileage outside the built-up area of the city, has produced very creditable results. Some 55 miles of route are in use, and 5,331,000 car-miles were run during the year in question (ending March, 1908). Altogether 47,839,569 passengers were carried, the revenue per car-mile being 10·946d., and expenditure 7·26d. The total revenue of the department amounted to £243,148; working expenses were £167,994, and after meeting financial charges a balance of £17,238 remained, as compared with a similar balance of £14,536 in the previous year. The net balance was credited to the reserve and renewals account, which now stands at £52,229. The parcels department carried 576,041 parcels, as compared with 528,637 in the previous year, and earned £1,259 profit. The manager calls the Committee's attention to the increasing cost of permanent way repairs.

Brentford.—The U.D.C. has again had under consideration the question of the state of the London United Tramway track. A letter was submitted from Sir J. Clifton Robinson *apropos* of Colonel Yorke's report on the recent B. of T. inspection of the section of the tramways in the Brentford district. The Council agreed to a request from the Hampton Council to appoint representatives to a conference with regard to the state of the track. The Chairman said he thought it a pity that the Council could not do something with regard to the under carriages of the cars which made the noise, but apparently it had no powers with regard to them.

Burnley.—The Tramways Committee has considered recommendations by the promoters of the Blackburn, Whalley, and Padiham Light Railway, asking for the approval of the Burnley Corporation to draft clauses to be inserted in an order to revive their powers. The draft clauses provided (*a*) that Padiham Council might within six months from the expiration of the Corporation's lease of the tramways in Padiham district, give notice requiring the Light Railway Co. to sell to it that portion of the company's undertaking within its district. The second clause related to working agreements with other councils or corporations. A letter was also read from the Padiham Council, asking whether the Corporation would entertain a proposal to extend its present tramway from the terminus at Padiham to the top of Padiham, and, if so, whether the Corporation would receive a deputation from the Council on the subject. It was agreed to support the proposals of the light railway promoters, but the T.C. could not see its way to extend the tramway beyond the existing terminus at Padiham.

Continental Notes.—GERMANY.—Trials are now being being made on the section between Berlin and Zossen of the motor-car train built by the Allgemeine Co. for the Royal Railway Administration of Konigsberg. It consists of two motor-cars equipped with 84 storage cells, which are capable of yielding, it is said, 75 H.P. and of enabling the train to travel a distance of 62 miles before the cells require recharging. The first trial preliminary to acceptance for service in the district of Konigsberg took place recently between Breslau and Waldshen, a distance of about 17 miles, when a speed of 25 miles an hour was attained.

The Municipal Council of Schöneberg, a suburb of Berlin, has just sanctioned a scheme for the construction of an underground electrical railway. The project, it is understood, will cost M.10,200,000, and the contract will be entrusted to the Siemens-Halske Co.

The Baden State Railway authorities have decided to convert the railways between Bâle, Schopfheim and Zelle, and between Schopfheim and Sackingen to electric traction on the Siemens-Schuckert system.

NORWAY.—The first Norwegian electric railway, from Thamshavn to the Lokkens Mines, some 17 miles, was recently put into service. The line is equipped with the single-phase system; the primary pressure of 15,000 volts being transformed down to 6,600 volts for use on the overhead wire. The line is worked by locomotives and deals with a mixed traffic.

Douglas.—In answer to the Manx Electric Railway Co.'s suggestion as to leasing and electrifying the tramway and extensions, the T.C. has replied that the question of electrification was not at present before the Council, and it would not consider any scheme involving the leasing of the lines to a company.

Folkestone.—The result of the official poll on the tramway question is a slight majority in favour of agreeing to the alterations suggested by the Tramway Co.; a private poll taken by Messrs. Cobay Bros. shows a slight majority against the proposed amendments.

Halifax.—The report on the working of the tramways for the year ending March last, shows that 20,378,672 passengers were carried and 1,786,890 car-miles run. The revenue amounted to £81,872, and after meeting all charges a deficit of £9,605 remained. This figure includes compensation for the North Bridge, New Bank and Pye Nest accidents and the cost of relaying the Skircoat Road track.

Haslingden.—On Thursday last week, Major Druitt made an official inspection of the first portion of the tramways, viz., from Accrington to the Commercial Hotel, Haslingden. The overhead work, to Messrs. Handcock & Dykes's specification, is on the Pringle system, the contract having been carried out by Messrs. Dick, Kerr & Co. The line was to be opened for traffic on Saturday last.

Hastings.—A resolution recently before the T.C. was to the effect that the tramways company be asked if it will undertake the installation and working of railless electric vehicles from the Memorial to the top of High Street. The whole question of tramways in the Old Town has been referred to the Tramways Committee.

Hull.—As a steam fire engine was proceeding through the streets on Monday night, it came into collision with an electric car, the passengers, however, escaping injury. The firemen were all more or less injured.

London.—According to the *Daily Mail*, experiments are being conducted by the Highways Committee of the L.C.C. with the object of utilising portable electric batteries. The experiments have been conducted after midnight when the ordinary service had ceased.

Lytham.—The local tramway company has written to the U.D.C. asking on what conditions the Council would be prepared to take over the roadways in the district traversed by the tramways.

Manchester.—The deputation from the Tramways Committee, who lately visited Germany to inquire into the "trackless tramway system" in use there, will shortly present their report. It is understood to be favourable, and that it will recommend a trial of the system on one of the suburban roads, not at present served by the Manchester tramways. It is claimed for this system of electrically-propelled omnibuses, that it can be installed for about a third of the cost of an ordinary overhead tramway, and that it can be used on narrow roads, where single tracks with loop lines could not be worked; but, on the other hand, road repairs would be a costly item, and the expenditure in electrical energy would also be greater; besides which maintenance charges (including cost of rubber tires), would be serious. In this way, anything saved in the laying of the track, would to a great extent be neutralised. The working expenses per car-mile in Manchester last year were 7·07d.; the corresponding figure on a German trackless tramway is put down at 5·38d., which shows a possible saving of about 2d. per car-mile.

Newcastle-on-Tyne.—At a meeting of the T.C. on the 2nd inst., Mr. Rodgers moved the report of the Tramways Committee and the revenue account for the year 1907-8. The account showed a net profit on the year's working of £19,477, which the Committee recommended should be placed to the credit of the reserve and renewals account. Mr. Rodgers said the financial results of last year were not so satisfactory as they were in the previous year. That had been caused by the alteration which gave to the riding public greater facilities, and the unfortunate strike which commenced during the last ten weeks of their financial year. To emphasise this fact he mentioned that their income had been reduced by £49 per week on the average during the period he had named. Their receipts this year amounted to £205,322, against £205,261 in the preceding year—about £60 more—and the total income from all sources showed an increase altogether of £1,427; their total income having been £211,318, against £209,891 in the preceding year. On the other side they had, unfortunately, very large increases in the working expenses. No less than £9,534 more was expended last year than in the year before. Thus their total expenditure was £116,000, against £107,000 the year before. After meeting their various liabilities they had £55,907 to carry to the appropriation account. Out of that latter sum they had the sinking fund to provide for, amounting to £34,878, and £1,551 to pay to liquidate the debt on the old horse cars, and after meeting those debts they had left a total profit of £19,477, which the Committee recommended should go to the reserve fund. Up to the end of the year they had in the reserve fund £43,514, and if they added to that amount, the sum he had named, it would make £62,922 in their reserve fund. In addition to paying that reserve fund, they had also paid since the installation of the present system no less than £197,082 in interest, and they had paid off their debt, £187,699.

Perth.—Several items in the Corporation accounts are criticised by the official auditor. Regarding the tramways, he says no allowance for depreciation of plant has been made in bringing out the loss of £1,264 on the tramway undertaking, shown in the accounts; and, further, the sinking fund instalments debited therein, only cover fixed loans, and do not provide for the repayment of the overpaid balances of £2,172 on the capital account. Then, in the electricity department, the auditor says only small sums had been laid aside during the year out of revenue for reserve and depreciation.

Rochdale.—At the last monthly meeting of the T.C., it was stated that terms were arranged for extending the tramways from Ending through the Whitworth Valley to the Red Lion at Shawforth, a distance from Ending of 3¼ miles. The terms are that Whitworth Council shall make application for an order under the Light Railways Act, 1898, and bear the cost of the construction and electrical equipment of the line, and renewing the permanent way, and the Rochdale Corporation shall maintain and keep the same in good working order; the Rochdale Corpora-

tion to work the line for a period, co-extensive with the period allowed for the repayment of the loan for the construction thereof, and to make an annual payment to the Whitworth Council sufficient to cover the payment by that Council in respect of interest and sinking fund on the necessary loans for such construction. The Rochdale Corporation is to do the work and find the money. The Whitworth Council is recommended to approve of Rochdale's terms, provided Rochdale will allow £200 per annum in addition to interest and sinking fund for road maintenance.

South Africa.—Several proposals have lately been made for extending the electric tramways to one or other of the suburbs around Johannesburg, the most recent under consideration being to Brixton. A largely attended meeting was recently held for the purpose of considering the details. Mr. A. Hewson, chairman of the Ratepayers' Association, said that, according to the figures he had before him, the cost of taking the line to the spot proposed for its termination was £19,600, and the working of the line would show an annual profit of £8,798. Councillor Jeppes, chairman of the Tramways Committee, addressed the meeting, and said the Committee had only £30,000 at its disposal, and he could not see that it was feasible to undertake the construction of any new lines. The figures he had prepared in regard to the cost of the line proposed differed essentially from those given by the chairman. The real cost would be £50,000, the subway alone absorbing £23,000.—*South Africa.*

United States.—The trouble which has been brewing among the New York drivers, conductors and other employés on the street railways came to a climax recently, when the men, by a large majority, voted in favour of a strike against the present wages scale and conditions of service. Over 32,000 persons will be affected.

Yarmouth.—The Tramways Committee has declined to issue season tickets, on the ground that the experience of other towns is that such a system is financially unfavourable; the Committee has also declined to entertain an application by the Guardians for the issue of yearly tickets to their officials for use while on duty.

TELEGRAPH and TELEPHONE NOTES.

British Honduras.—In the Colonial Report for 1907, the acting Colonial Secretary states that during the year 19,023 telephone calls were dealt with, as against 14,887 for the previous year, while 12,089 telegrams were transmitted, as against 10,195 for the previous year. The working expenses amounted to $9,398 (£1,879), and the receipts to $5,465 (£1,093), thus leaving a deficit of £786. The Colonial Secretary states that the Northern line is now fairly regular, while the Southern line is being improved. He adds that there is no regular through communication with places beyond the colony; but a private firm has made arrangements for receiving telegrams at Consejo in this colony, sending them by boat to Payo Obispo and then transmitting them by the Mexican line. This line has been subject to occasional interruptions, but usually telegrams sent to or from Belize reach their destination within 24 hours. Negotiations are in progress with the Mexican Government for the establishment of a through service.

German Cables.—We are informed by the Deutsch-Atlantische Telegraphengesellschaft that our note under this heading last week was incorrect; the German Co. owning the Emden-Vigo cable did not obtain the concession for the Teneriffe cable, the latter having been granted to Messrs. Felten & Guilleaume. The statement quoted from the *Financial News* was also inaccurate, as the cable is being manufactured by the Norddeutsche Seekabelwerke, Nordenham a.d. Weser.

New Telegraph Offices.—The following new telegraph offices have been opened in Cuba, viz., at Arroyodrenas, Auras, Hoyo Colorado, Managua, Punta Brava, San Jose de las Lajas, Santa Cruz del Norte and Santa Maria del Rosario, in the Province of Havana, and at Caimito and Velasco, in the Province of Oriente, while one has also been opened at Marti, in Matanzas.

A new telegraph office has been opened in what is known as the Third Region, at Costi, while the office at Stillet Abbass has been closed. A new telegraph office has also been opened at Seeheim, in German South-West Africa.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo } Closed	Jan. 12, 1906 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Las Palmas—Arrecife	May 18, 1908 ..	..
Pera-Dardanelles	May 20, 1908 ..	..
Sierra Leone-Accra	May 28, 1908 ..	..
Kwandang-Menado	Aug. 5, 1908 ..	Sept. 7, 1908.
Djedda-Sonakim	July 27, 1908 ..	..
Assab-Massouah	July 28, 1908 ..	..
Cadiz-Teneriffe	Aug. 20, 1908 ..	..
Cotonou-Lagos	Aug. 29, 1908 ..	..
Paramaribo-Cayenne	Sept. 3, 1908 ..	..

Wireless Telegraphy.—It is announced from Copenhagen that Waldemar Poulsen, the Danish engineer, has just carried out a series of interesting experiments in the direction of high-speed wireless telegraphy with new apparatus devised by him. The fast system is intended for use over the ocean, and the new Poulsen apparatus, corresponding to the Wheatstone apparatus, is said to fully attain the capacity of the latter. The provisional experiments, which were conducted between the stations at Lyngby, near Copenhagen, and Esbjerg, on the west coast of Jutland, are declared to have resulted in the transmission of about 100 words per minute, and the inventor calculates that he will soon succeed in telegraphing 150 words a minute. It is added that the trials will, in the immediate future, be continued between Lyngby and Tynemouth, and new stations are being erected on the west coast of Ireland and in Canada, between which the high-speed system is to be employed.

Telegraphic communication is now open with Iquitos, on the River Amazon. The means of connection from Lima to Puerto Bermudez is an ordinary wire telegraph line, but from Puerto Bermudez to Iquitos, the distance of about 1,000 km., including long stretches of primeval forest, is bridged by wireless. The original intention of the Peruvian Government to connect Iquitos with the outside world by wire was given up on account of the immense difficulty and cost. The Telefunken Co., which put in the system, succeeded in establishing the service on the whole "line" within two years. The expense of installation, defrayed by the Peruvian Government, reached about $200,000.—*Electrical World.*

It is rumoured that an Australian inventor has devised a system of wireless telegraphy far superior to existing systems; particulars, however, are not yet available.

The Belgian Administration notifies that the wireless station at Nieuport is now open for the acceptance of messages to the public.

Wireless Telephony.—According to the *Daily Chronicle*, Dr. Lee de Forest, who has come to London to submit to the British Admiralty his latest inventions, confidently predicts that wireless telephony will shortly be practicable over long distances. It is stated that the U.S. warships are able to converse at a distance of 40 miles and that Dr. de Forest's newest apparatus has a range of 75 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Adelaide.—October 2nd. G.P.O. Power plant for charging accumulators for telegraph purposes.

Adelaide.—November 20th. The City Council requires tenders for the supply and erection, complete, of a refuse destructor, electric lighting plant for same, &c. Particulars may be obtained from the Agent-General for South Australia, 1, Crosby Square, Bishopsgate Street Within, E.C.

Tasmania.—November 2nd. Tenders will be received at the office of the Deputy Postmaster-General, Hobart, for the supply and delivery at Hobart of material for accumulator equipment for telegraph purposes. Tender forms, specifications, &c., may be seen at this office.

South Australia.—October 21st. Tenders will be received at the office of the Deputy Postmaster-General, Adelaide, for a power plant for charging accumulators for telegraph purposes at the General Post Office, Adelaide, as per specification No. 228. Specifications can be seen at this office.

Western Australia.—October 6th. Tenders will be received at the office of the Deputy Postmaster-General, Perth, for the supply of telegraph and telephone material. Specifications may be seen at this office.

Melbourne.—September 23rd. Insulated copper cable for the City Council.

October 19th.—Four sets of instruments for direct duplex cable working, for the Postmaster-General's department. See "Official Notices" to-day.

Belgium.—Antwerp.—September 21st. The Commercial Intelligence Branch of the Board of Trade has received from H.M. Consul-General at Antwerp, a copy of a specification issued by the municipal authorities of that city in connection with a call for tenders for the electric lighting of the municipal "Salle des Fêtes," Place de Meir. A deposit of 12,000 fr. (about £480) will be required. The specification may be obtained at the Hôtel de Ville, at a cost of 0.50 fr. A copy may be inspected by British contractors interested, on application at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Blackpool.—September 19th. 100 tons of steel rails, 30 cwt. of fish-plates, 20 cwt. of tie-bars, and about 300,000 hardwood paving blocks, also taking up and relaying about 823 lineal yards of double-track tramways, for the T.C. John S. Brodie, Borough Engineer, Town Hall, Blackpool.

Canada.—The Ontario Hydro-Electric Power Commission will call for tenders shortly for transforming stations. The stations will be 12 in number, and will be built at Niagara Falls, Dundas, Toronto, Brantford, Woodstock, London, Guelph, Preston, Berlin, Waterloo, Stratford, St. Mary's and St. Thomas.

Chile.—The Chilian State Railway authorities in Santiago are inviting tenders until November 2nd for the establishment of a central electricity-generating station of a capacity of 900 KW.

Dublin.—September 11th. Electric lighting works at the State apartments, Dublin Castle. Specifications, &c., to be seen at the office of H. Williams, Secretary, Office of Public Works, Dublin.

Egypt.—October 29th. The Ministry of the Interior wants tenders for the installation of electric lighting in the town of Zagazig, in accordance with specifications and plans that may be inspected at the offices of the above Ministry at Cairo.

Germany.—POSEN.—Tenders are about to be invited by the municipal authorities for the extension of the electric lighting undertaking, at an estimated cost of £75,000.

ENSHEIM (ZWEIBRUCKEN).—The municipal authorities are about to invite tenders for the construction of an electric tramway in the town.

HAMBURG.—September 25th. The "Finanzdeputation" wants eleven electric travelling cranes. Conditions of tender may be purchased for 15 marks, at Sekretariat II, "Finanzdeputation," Hamburg.—*B. of T. Journal.*

SAARBRÜCKEN.—September 28th. The State Railway Administration, St. Johann Saarbrücken, invites tenders for the supply and fixing of an electric turntable for locomotives, of 20 metres diam. Conditions, plans and form of tender may be obtained at the above-mentioned Administration, Room No. 218, on payment of 5 marks (not in postage stamps).—*B. of T. Journal.*

Ilford.—September 22nd. Overhead travelling crane for the U.D.C. See "Official Notices" September 4th.

Merthyr Tydvil.—September 19th. Messrs. Hills, Plymouth & Co., Ltd., invite tenders for stores for electric appliances for their collieries for 12 months ending September 30th, 1909.

Rotherham.—September 14th. Extension of switchboard, foundations, girder work, &c., for 500-KW. turbo-generator for the T.C.

Russia.—September 14th. The Town Clerk of Odessa (Upiawa) requires tenders for a concession to erect and work a power and lighting supply. A central station of a minimum of 6,000 H.P. is to be erected and equipped.

Salford.—September 14th. Lighting and power feeder and distributor pillars for the Electricity Committee. See "Official Notices" August 28th.

Spain.—HUELVA.—September 29th. Two electrically-driven cranes and tip wagons. Junta de Obras del Puerto.

VILLANUEVA DE CORDOBA (Province of Cordoba).—The municipal authorities have just invited tenders for the concession for the electric lighting of the town during a period of 15 years.

Tenders are being invited until the 19th inst. by the municipal authorities of Cambil (province of Jaen) for the concession for the electric lighting of the town during a period of 30 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Cambil (Jaen).

The municipal authorities of Campdevanol (province of Gerona) have just invited tenders for the concession for the electric lighting of the town during a period of five years.

Taunton.—The T.C. requires tenders for a 150-B.H.P. compound condensing engine, for coupling to a generator.

CLOSED.

Belgium.—Tenders were opened last week by La Société des Chemins de Fer Vicinaux, of Brussels, for the supply of a large quantity of electric cable. Quite a number of concerns competed for the contract, the lowest offer, however, being that of Callender's Cable Construction Co., Ltd., London, who quoted £4,348.

Bradford.—The T.C. has accepted the tender of Hadfield's Steel Foundry Co., Sheffield, for the supply of steel points, crossings, &c., for the tramways, at £455; and that of Messrs. Collinson Bros., 3, Millergate, Bradford, for the electric light installation at the tramway offices at Hall Ings, at £146.

Bristol.—The Electricity Committee has placed an order with Messrs. Bruce Peebles & Co., Ltd., of London and Edinburgh, for an additional 500-KW. motor-converter set for Temple Back Electricity Works. This is the second repeat order for machines of this capacity, and Messrs. Bruce Peebles & Co., Ltd., have already supplied to the Bristol authorities five 500-KW. and three 300-KW. motor-converters.

The T.C. has entered into the following contracts:—

T. Lovell & Sons.—Superstructure of Shirehampton sub-station, £419.
British Thomson-Houston Co., Ltd.—Direct-current power switchgear for Avonmouth Docks, £177 5s.
Siemens Bros. Dynamo Works, Ltd.—Two power distribution boards for Avonbank, £365 14s.

Burnley.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., of London, to supply and fix a 750-KW. steam-driven generating set at the electricity works for £3,925.

The Tramways Committee has resolved to accept the tender of Messrs. Hurst, Nelson & Co., of Motherwell, for five car bodies at £339 each; it was decided to build the trucks for the five cars in the shops of the Corporation's tramway department, at an estimated cost of £110 per car. The tender of the British Thomson-Houston Co. to supply the electrical equipment required for the five cars, at the sum of £362 10s. per car, was accepted.

Dewsbury.—The T.C. has accepted the following tenders:—

Lancashire Dynamo Co., Ltd.—Reversible booster and switchgear.
Tudor Accumulator Co.—Storage battery.
Callender's Cable and Construction Co., Ltd.—2,000 yards of traction cable and 1,000 yards of pilot wire.

Dundee.—Messrs. G. H. Nicoll & Co., Dundee, have secured the contract for smith work, electric installation, telephones and electric bells for a new school being erected at a cost of £20,000.

Malvern.—The U.D.C. has accepted the tender of the British Insulated and Helsby Cables, Ltd., for cables, for the extension of the mains to Malvern Mills.

Manchester.—The Lancashire Dynamo and Motor Co. has received an order for a three-wire hand-reversible booster for the Manchester Corporation.

Perth.—Messrs. A. Westwood & Co., Perth, have secured the contract for the electric lighting, &c., of the new city hall for Perth.

Reigate.—The T.C. received the following tenders for condensing plant and cooling tower at the electric lighting station:

Isaac Storey & Sons, Ltd. .. .. (accepted)	£935
Blasberg Engineering Co.	1,975
D. Stewart & Co. (1902), Ltd.	2,465
Worthington Pump Co., Ltd.	1,882
Société Anonyme Westinghouse	1,314
Belliss & Morcom, Ltd.	2,048
Willans & Robinson, Ltd.	1,547
Balcke & Co.	1,314

Torquay.—The T.C. has accepted the tender of Messrs. Belliss & Morcom, Ltd., for machinery at the electricity works, at £1,365.

Wrexham.—The tender of Messrs. Jas. Gordon & Co., of London (£165 5s.), for superheater, piping, &c., has been accepted by the Town Council, for the electricity department.

CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABBOTS LANGLEY (HERTS).—House, shop, and stables, Breakspeare Road, for W. Carter.

ABERDEEN.—Fish curing premises at North Esplanade (East) for Mrs. Fletcher, Deemont Terrace; H. Mennie, architect. Dwelling house in Forest Road; R. Beattie & Sons, builders, W. Beattie, architect. Alterations at 64, St. Nicholas Street, for Stewarts, Ltd., clothiers, Middlesbrough. Boiler house for Aberdeen Steam Laundry, Claremont Street; J. Smith, consulting engineer. Alterations at 477, Union Street for Aberdeen Dairy Co., Ltd.; A. M. Mackenzie & Son, architects.

ALDENHAM (HERTS).—Houses, Park Road, Radlett, for Goodchild & Jeffery; Aldenham Avenue, Radlett, for W. G. Taylor.

ALDERSHOT.—Proposed garage in Halimote Road for the Aldershot and Farnborough Motor 'Bus Co.

ALLOA.—Extension of County Buildings (£5,000). Melvin & Kerr, architects, 30, Mar Street, Alloa.

ASHFORD.—Alterations and additions to Co-operative Stores. A. E. Lacey, architect, Ashford; D. Godden & Sons, builders, Ham Street, Orlestone, Ashford.

ASHTON-UNDER-LYNE.—Electric lighting installation at the workhouse; Board of Guardians.

AUDLEY (N. STAFFS.).—New Council school in Wood Lane (280 children). G. Balfour, Director of Education, County Education Offices, Stafford.

BARNSLEY.—New school at Ardsley, for the West Riding Education Committee; A. B. Linford, architect, Wombwell, near Barnsley. Houses, Rockingham Street; C. L. McLintock, architect, 28, Church Street, Barnsley. Houses, Harvey Street, for Alfred Porter; Britannia Street, for A. Winter.

BEDWAS (MON.).—Two houses at Bedwas. J. Gibbon, Bedwas.

BELFAST.—Two detached villas at Knockdene Park, Knock. Young and Mackenzie, architects, Scottish Provident Buildings, Belfast.

BILLINGE (near WIGAN).—Waterworks developments. Surveyor, Council Offices, Billinge.

BIRKDALE.—Houses, Hatfield Road, Ainsdale, for W. C. Lewis; Shore Road, Ainsdale, for Mrs. Hodgkinson; Belvedere Road, Ainsdale, for T. Holmes; Chatsworth Road, Ainsworth, for J. Ward and Son.

BIRMINGHAM.—Probable rebuilding, after fire, of factory in Station Road, for H. E. Jordan, basket and chair maker.

BIRSTALL.—Dwelling house, stable and coach-house. J. Beans, builder, Birstall, Yorks.

BITTERNE (HANTS.).—Twenty-one model cottages. Guy Prendergest, architect, Sholing.

BLACKBURN.—Houses, Roman Road, for Albert Hall; alterations to premises in Accrington Road, for the Daisyfield Industrial Co-operative Society; additions to mill, Kingston Place, for the Lower Darwin Investment Co., Ltd.

BLACKBURN.—Swimming bath at the Blakey Moor Higher Elementary School. Town Council.

BLAYDON (Co. DURHAM).—New rectory at Winlaton (£1,500).

BLYTH.—Mechanics' institute for the workmen of the New Delaval Colliery.

BRADFORD.—New Council school at Buttershaw. F. E. P. Edwards, city architect, Whitaker Buildings, Brewery Street, Bradford.

BRADFORD ABBAS (near SHERBORNE).—Extensive alterations at "Combe," for Col. Duff, C.B. Bird & Pippard, builders, Yeovil.

BRAY (near MAIDENHEAD).—Houses, Cannon Lane, for F. Pearce; Drift Road, for J. Headington.

BRENTWOOD.—Rebuilding the gymnasium at the Grammar School.

BRIDLINGTON.—Proposed new school. Bridlington Education Authority.

BRIERLEY HILL.—Proposed Temperance Hall in Trinity Street.

BRISTOL.—Fitting up new natural history department in Corporation Museum (£2,000). H. Bolton, curator, Museum, Queen's Road, Bristol.

BRISTOL.—Rebuilding Nos. 75 to 79, Victoria Street. La Trobe & Weston, architects, 44, Corn Street, Bristol.

BROMLEY.—Secondary school for girls, Nightingale Lane. W. H. Robinson, architect to the Kent Education Committee, Caxton House, Westminster, S.W.

BROMSGROVE.—Probable re-erection (after fire) of factory for Victor Drury boot manufacturer.

BROUGHTY FERRY.—Alterations and additions to the Grove Academy.

BUCKHAVEN.—Proposed new hospital in memory of Captain Wemyss.

BURNLEY.—Wesleyan School in Florence Street; Rev. C. S. Sargisson, Burnley. Primitive Methodist Chapel in St. Matthew Street; Rev. R. Reeve, superintendent minister, Burnley.

Houses, Woodgrove Road and Outwood Grove, for Smith Bros., Ltd., builders, Eastham Place; houses and shops, St. Matthew Street, for A. Heap; houses and shop, Back Lane, for W. Whittaker.

BURSLEM.—Additions to the Suburban Club, Wade Street; W. Grant & Sons. Two new shops, Queen Street; F. Wilson. Alterations to shop premises, Brownhills; W. H. Steele. Proposed central school in Moorland Road; Clerk to Burslem Education Committee.

BURY.—Proposed new Secondary School, for the T.C. Premises, corner of Fleet Street and Crompton Street; J. Horsfall, architect, Bury Messrs. Tinline, builders, Bury.

CAMBRIDGE.—Extension of the Post Office. Postmaster, Cambridge.

CANNOCK.—Houses, Pye Green, for Benjamin Powis; High Mount, for Geo. Shepherd; John Street, Chadsmoor, for E. Lane; Mill Street, for Mrs. Wooding; shops, Wolverhampton Road, for W. Morgan.

CARDIFF.—Conversion into shops of 44 and 46, Crwys Road, for R. W. Nicholas; W. H. D. Capel, architect, 2, Church Street, Cardiff. House, Cefncoed Road; W. Green, builder, Cathays, Cardiff.

CARRBRIDGE (INVERNESS-SHIRE).—New United Free Church.

CHESTERFIELD.—Mission Church at Grassmoor (seat 250). T. S. Wilcockson, architect, Chesterfield.

CHESTERTON (CAMBS.).—House, George Street, for H. C. Buttress; laundry, 56, Victoria Park, for Mrs. Jane Hunt.

CHORLEYWOOD (near RICKMANSWORTH).—House, Station Road, for R. Emery; Mission Church, Quickley Lane, for the Committee.

CLACTON-ON-SEA.—House, Wellesley Road, for A. W. Coleman; flats, Coopers Lane, for Mrs. Barron; additions to premises, Olivers Road, for H. Hurst.

COATBRIDGE (N.B.).—Rebuilding Douglas Support (mansion) for Lord Blythswood.

COLCHESTER.—Electric power installation, works of Spottiswoode & Co., and other firms.

COOKHAM.—Detached house, Furze Platt, for A. Streeter.

COVENTRY.—Bakery at the workhouse for the B.G.; T. F. Tickner, architect, High Street Chambers, Coventry. New St. Mark's Church Institute; T. F. Tickner, architect, as above.

CREWE.—Extensions to Bedford Street Schools (£10,000) and proposed new elementary school, Derby Street; Local Educational Committee. Nine houses, Gainsborough Road, for Mrs. W. Wade.

CRIEFF.—Monzie Castle (£20,000). W. S. Cruickshanks & Son, building contractors, Lower Gilmore Place, Edinburgh.

DENABY.—Blocks of model houses at Woodlands. Brodsworth Main Colliery Co.

DEVONPORT.—Proposed new parsonage and church at Weston Mill, for the Three Towns Church Extension Committee, Exeter.

DINAS POWIS.—Bungalow at Cross Field; G. Hartland, builder, Dinas Powis, Cardiff. Two villas, Greenfield Avenue; J. H. Rees, Dinas Powis. House and shop, Elm Grove Road; W. E. Matthew, builder.

DONCASTER.—New Sunday Schools at Brodsworth. H. Beck, architect, Dolphin Chambers, Doncaster.

DRUMBLADE (ABERDEENSHIRE).—Renovation of U.F. Church. Rev. A. S. Marshall, minister.

DUNDALK.—New office on the station platform, and conversion of stores building into fitting shop, for the Great Northern Railway Co. (Ireland). W. H. Mills, engineer-in-chief, Amiens Street Terminus, Dublin.

DUNSTABLE.—Farm buildings at Toddington. E. T. Tutt, architect, Market Place, Ampthill.

DURHAM.—Houses near the Garden House, North Road, for J. F. Bell; additions to Lloyd's Bank; addition to Johnston Technical School; additions at Old Elvet, for T. Forster.

EASTBOURNE.—Houses, Langney Road, W. Llewellyn; Milton Road, L. P. Newman; Baslow Road, C. C. Cotterill; addition, Avenue House, Guardians of the Poor; alteration, Sussex Hotel, Bass and Co.; carpenters' shop, Hillbrow, Bolsover Road, Thornton and Hunt.

EBCHESTER (Co. DURHAM).—Four houses and shops at Chopwell, for F. Rupp. D. M. Spence, architect, Shotley Bridge.

ELLAND.—New spinning mill, Spa Well Lane. J. Fielding & Co.

ELLESMERE PORT.—New offices for the U.D.C. Sproat & Warwick, architects.

EVESHAM.—School master's house at Bretforton. F. White, builder, Evesham.

EVESHAM.—New secondary school (£8,553). H. T. Buckland & Haywood-Farmer, architects, Birmingham.

FALMOUTH.—Two houses for John Chard, senr., in Swanpool Street; H. E. Tresidder, architect. Detached residence for W. H. Wellsteed; in Gyllyngdune Lane; H. E. Tresidder, architect. Additions to "The Crossways," Pennance Road, for Mrs. Rogers; Mr. Kinnaird-Jenkin, architect.

FARNHAM.—Two houses in Weydon Hill Road. F. Baker, builder.

FAVERSHAM.—Re-erection of premises (after fire) for H. S. Tett, Ltd., ironmongers, Market Street.

FLEETWOOD.—New pier with pavilions, offices, &c. Urban District Council.

FLAXTON (YORKS.).—Sewage disposal works and lifting machinery for the R.D.C. F. J. Commin, engineer, 1, Victoria Street, Westminster, London.

GILLINGHAM.—Alterations and additions, 27, Rosebery Road, for W. F. Turner; additions to Gospel Hall, for Mr. Crawe; houses, Napier Road, for W. H. Farr; Cross Street, for D. Gigney; York Avenue and Marlborough Road, for Mr. Silver; Napier Road, for Mr. Wardle; proposed installation of electric cranes at the wharves by the T.C.

GLASGOW.—Three tenements of dwelling-houses and shops in Great Western Road, for John Anderson, 27, St. Vincent Street; church and offices, at 27-31, Rose Street, Garnet Hill, Rev. A. G. Knight, 111, Mount Street, London; warehouses, &c., at 61-65, Glassford Street, Gordon Bros., warehousemen, Glassford Street; buildings for offices, &c., at 84-94, St. Vincent Street, Northern Assurance Co., Ltd., 90, St. Vincent Street.

GORSEINON (GLAM.).—Bakery and stables for Oliver Watkins; new church for the trustees of Ebenezer Church.

GOWERTON (GLAM.).—Houses, Talbot Street, for Fred Simkin.

GRAVESEND.—Additions to St. John's Catholic Schools. G. E. Clay, architect, 27, King Street. Gravesend.

GREENFIELD (near OLDHAM).—New waterworks. Ashton and Stalybridge Corporations.

GREENOCK.—Shops and dwelling-houses, corner of Drumfrochar Road and Ann Street; T. Hayman, Somerset Place, Glasgow. Dwelling-houses in Carwood Street; A. Stevenson, builder, Wellington Street, Greenock.

GUILDFORD.—Buildings at the waterworks, Millmead, for the T.C. G. C. Mason, borough surveyor, Tuns Gate, Guildford.

HALIFAX.—Extensions to Clifton Mills, Bailiff Bridge; J. F. Walsh and G. Nicholas, architects, Museum Chambers, Halifax. Reconstruction of premises for the Industrial Society, including electrical work; W. C. Williams, architect, 29, Southgate, Halifax.

HARTLEPOOL.—Additions to Moor House, Friar Terrace, for Dr. Gibb.

HEMSWORTH (YORKS.).—Houses, South Elmsall, for J. W. Townend; Brierley, for E. Hoyland; South Hiendley, for Mrs. A. Owram.

HERNE BAY.—Houses, St. George's Terrace, for J. Manley Birch; R. Messenger, architect, 16, High Street, Herne Bay. Houses, Southcliffe Drive, for T. Wiffen.

HEYSIDE (near OLDHAM).—New vicarage. Wilson & Roberts, builders, Stalybridge.

HEYWOOD.—New Council school at Heap Bridge. Heywood Educational Authority.

HORWICH (LANCS.).—Detached house, Princess Road, J. E. Partington; four houses, Tomlinson Street, P. Carroll. New infants' school; H. Littler, architect. County Architect, Preston.

HUDDERSFIELD.—Alterations and improvements to the Huddersfield Lock-up. J. Vickers-Edwards, County Architect, County Hall, Wakefield.

INVERKEITHNEY (BANFFSHIRE).—Alterations at Easterfield School. W. L. Duncan, architect, Turriff.

INVERNESS.—Masonic hall for St. Mary's Lodge, No. 339.

INVERSHIN (SUTHERLAND).—New United Free Church manse at Rosehall.

KIDDERMINSTER.—Church and schools to be lit by electricity (£2,500). Pritchard & Pritchard, architects, Kidderminster; R. Thompson, builder, Park Lane, Kidderminster.

KING'S NORTON.—New schools (£14,350). Pritchard & Pritchard, architects, Kidderminster.

KIRKCALDY.—Tenement for 24 tenants at Sutherland Street, for P. Beaton; shop and tenements at Ramsay Road and Pratt Street, for William Kilgour; 12 stores for Nairn & Co.'s linoleum works at Den Road; eight shops and seven dwelling houses and office, in Commercial Street and St. Clair Street, for R. Blyth, solicitor; alterations to Leishman's brewery, for J. Rintoul.

LAMBTON (DURHAM).—New collieries being sunk near Lumley Castle. Lambton Collieries Co., Ltd., Durham.

LASSWADE (MIDLOTHIAN).—New Carnegie Library at Bonnyrigg (£2,000).

LEEDS.—Alterations at the Woodlesford Provided School. R. J. Smith, Education Offices, Garforth, near Leeds.

LEITH.—Reconstruction, after fire, of 19, Fox Street, for W. Crawford & Sons, Ltd., biscuit manufacturers, Elbe Street, Leith.

LETCHWORTH.—Important extension of factory for the Kosmos Photographics, Ltd., London.

LEYLAND.—Eight houses in Alice Avenue. G. Gregson.

LINTHWAITE (YORKS.).—House and shop, Causeway Side, Hoylehouse. Lunn & Kaye, architects, Milnsbridge.

LIVERPOOL (ALLERTON).—Large houses in Calderstones Road. Messrs. Owen, builders, 18, Coventry Road, Church Road, Wavertree, Liverpool.

LLANDAFF.—Six houses, Cathedral Road; J. H. Venning, builder, Llandaff. Six houses in Australia Road, Gahalfa; G. Burgess, builder, Whitchurch.

LLANISHEN.—House, Station Road. W. D. James, builder.

LLANTRISANT.—Two semi-detached villas at Cross Inn. J. Stanley Griffiths, architect, Llantrisant.

LOCHGELLY (FIFE).—New laundry buildings in Cartmore Road. J. T. Scobie, architect, Dunfermline.

LOCKWOOD (near HUDDERSFIELD).—Detached house, Woodside Road. J. B. Abbey & Son, architects, 31A, New Street, Huddersfield.

LONDON (HACKNEY, N.E.).—Workshop, De Beauvoir Road; G. Keetch, builder, 49, De Beauvoir Road, Hackney. Six houses; W. M. Dabbs & Son, builders, 19A, Goulton Road, Lower Clapton, N.E. Two new warehouses and addition to one warehouse, Belsham Street; Hodson & Whitehead, architects, 7, Finsbury Square, E.C.

(WEST EALING, W.).—New school in Cranmere Road. C. Jones, borough engineer, Town Hall, Ealing, W.

(MORTLAKE, S.W.).—Ward block, &c., at the Isolation Hospital, South Worple Way, for the Barnes U.D.C. G. B. Tomes, surveyor to Council, Council House, High Street, Mortlake, S.W.

(CAMDEN TOWN, N.W.).—Prospective rebuilding of premises, corner of Miller and Arlington Streets, for A. Bishop & Sons, furniture warehousemen.

(S.E.).—Probable rebuilding, after fire, of Barclay, Perkins & Co.'s bottling department, Southwark Bridge Road.

(Bow, E.).—Public conveniences (electric light to be installed). H. Heckford, borough surveyor, Town Hall, Poplar.

(POPLAR, E.).—Addition to premises in Roach Road, for International Harvester Co., 80, Finsbury Pavement, E.C.

(TEMPLE, E.C.).—Alterations to Temple Church (£1,000). Reginald Blomfield, architect, 1, New Court, Temple, E.C.

(TOTTENHAM, N.).—Rebuilding 324, High Road. H. S. Couchman, architect, 520, High Road, Tottenham, N.

(NEW CROSS, S.E.).—Additions to "Amersham Arms," public house, 388, New Cross Road, for S. P. Janes.

(WILLESDEN, N.W.).—New station for Metropolitan Railway Co. M. Garbutt, architect, Bishops Road Station, Paddington, W.

(UPPER CLAPTON, N.E.).—Four houses. G. H. Paine, architect, 62, Moorgate Street, E.C.

(NORBURY, S.W.).—Shops and houses. Whitehead & Co., builders, Clapham Road, S.W.

LONDON (Victoria Street, S.W.).—Adaptation of premises for branch of Williams, Deacons Bank, Ltd. W. Cubitt & Co., builders, 258, Gray's Inn Road, W.C.

(Homerton, N.E.).—Additions to factory premises, 146-148-150, High Street. G. S. Garey, builder, 48a, Old Street Hill, Clapton Common, N.E.

(Tottenham Court Road, W.).—Alterations to No. 88 (Dundee Dye Works). Dove Bros., builders, 15, Studd Street, Islington.

(Grosvenor Street, W.).—Alterations to mansion. Dove Bros., builders, 15, Studd Street, Islington.

(Grosvenor Square, W.).—Stabling, &c., Reeves Mews. Maple and Co., builders, Tottenham Court Road, W.

(Aldford Street, W.).—Buildings. Foster & Dicksee, builders, Rugby.

(Curzon Street, W.).—Alterations to mansion. Geo. Andrews and Co., builders, 39, Craven Road, Lancaster Gate, W.

(Battersea, S.W.).—Block of one-storey offices in Falcon Road, for L. and N.W. Railway Co. H. E. Lee, builder, Camden Works, Great Church Lane, Hammersmith.

(Pall Mall, S.W.).—New premises for Automobile Club on site of old War Office. E. K. Purchase, architect, 20 and 22, Maddox Street, W.

(New Southgate, N.).—Six houses. Moore & Nield, architects, 20, New Bridge Street. E.C.

LONGTON.—Important colliery developments by the Florence Coal and Iron Co., Ltd.

LUDLOW.—House, Clun Road, Craven Arms, for Mr. Bowen.

LUTON.—Houses, Reginald Street, for F. Chandler, builder, 78, Cromwell Road; Reginald Street, G. Kingham, builder, 106, Old Bedford Road; Avondale Road, C. H. White, builder, 72, Dunstable Road; St. Paul's Road, for W. Frost; Chatsworth and Portland Roads, for C. Jeyes; Dudley Street, for G. Brown; Hampton Road, for J. Frost; Avondale Road, for A. Pratt; Dunstable Road, for S. W. Johnson; bakery and stabling, Wimborne Road, for A. Turner, builder, 72, Hibbert Street; new factory, George Street West, for the Luton Cardboard Box Co., Ltd.; additions to factory, York Street, for J. Frost.

MALTON.—New Grammar School for the North Riding C.C. W. H. Brierley, architect, 13, Lendal, York.

MALVERN.—Additions to 5 and 6, The College. Henman & Co.

MALVERN LINK.—New county schools. Pritchard & Pritchard, architects, Kidderminster.

MANCHESTER.—New offices and warehouses, corner of Mosley Street. Wilson & Toft, builders, Manchester.

(Stretford).—Conversion of lecture hall and coffee tavern into Parish Hall, in connection with the parish church.

MARLOW.—House, Cromwell Gardens, for W. J. Morgan.

MIDDLEWICH.—Shop and house at Cledford, for the Winsford Co-operative Society. Wm. Fryer, secretary, 21, High Street, Winsford.

MIRFIELD (Yorks.).—Detached house, Hopton Lane. A. W. Waddington, architect, 28, East Parade, Leeds.

MORCHARD BISHOP (Devon).—Conversion of premises in Lapford into three residences. J. A. Lucas, architect, Guildhall Chambers, Exeter.

NETHERNE (Surrey).—Isolation Hospital at the Surrey County Asylum. G. T. Hine, architect, 35, Parliament Street, Westminster, S.W.

NEWARK.—New collieries for the Coal and Iron Development Syndicate. J. Thom, contractor, Patricroft, Manchester.

NEWBRIDGE (Mon.).—Thirteen villas for Newbridge Building Club. A. J. Bowen, architect, Crown Street, Crumlin.

NEWBRIDGE (Co. Kildare).—Married Soldiers' Quarters at Newbridge Barracks. Director of Barrack Construction, Newbridge.

NEWCASTLE-ON-TYNE.—Station buildings at Walker Gate, for the North-Eastern Railway Co. Wm. Bell, company's architect, York.

NEW DELAVAL (Northumberland).—New Church in connection with Horton Parish.

OLDBURY.—Houses, Barclay Road, for F. J. Butler; Causeway Green, for A. Hadley; Galton Road, for T. Tay; Galton Road, for M. Davis; Harborne Road, for Mackenzie & Charlton; Frederick Road, for A. Bishop; Hales Lane, for H. Page and H. Swain; shops and houses, Tal Bank Road, for W. Oakes; vicarage, Rounds Green, for Rev. L. Gabbott.

PADSTOW (Cornwall).—New schoolroom in connection with the United Methodist Church.

PENDLETON.—Extensions to engineering works for Lancaster & Tonge.

PENTYRCH (Glam.).—House on Main Road at Gwaelodygarth; W. G. James, builder, Pentyrch, Glam. House on Main Road at Gwaelodygarth; E. Champion, builder, Pentyrch.

PERTH.—New saloon and alterations to shop for R. A. Storey, draper, 57, South Methven Street, Perth.

PICKERING.—Proposed Weights and Measure Office for the North Riding of Yorks C.C. W. H. Brierley, architect, 13, Lendal, York.

PONTEFRACT.—Houses (13), Friarwood Lane, for Walker and Ward.

PONTYPOOL (Mon.).—New wing at the Pontypool Hospital (£2,000). Gift of J. C. Hanbury, Pontypool Park, Mon.

PORTH.—Two shops in Hannah Street, for J. Preece, ironmonger. W. D. Thomas, architect, Porth, Glamorgan.

PRESTON.—Alteration and enlargement of premises, Walker Street, for the Preston Association.

PWLLHELI.—Renovation of the Llanengan Parish Church (£1,750). Rev. H. R. Roberts, Llanengan Rectory, Pwllheli.

QUEENBOROUGH (Kent).—Houses, Minster Estate, for Mr. Harvey; Southdown, for Hancock & Kettle; works, Rushenden Estate, for the Queenborough Pottery Co.

RADYR.—House on main road. S. Seward, builder.

REIGATE.—House, Plough Road, Burstow, for Alfred King, Smallfields, Horley; additions to Hooley Lodge, Chipstead, for F. T. Bowen.

RETFORD.—Rebuilding premises, Carolgate and Grove Street, for Fletcher and Sons, Ltd.; additions to works, Hallcroft Road, for Clark and Co.

ROCHDALE.—New church at Crompton. J. T. Henthorn, architect, Shaw; Wilson & Roberts, builders, Stalybridge.

ROSCREA (Co. Tipperary).—Alterations and additions to the Post Office. H. Williams, secretary, Office of Public Works, Dublin.

ROTHERHAM.—Business premises and two houses, corner of Fitzwilliam and Cottenham Roads, for the Masbro' Equitable Pioneers' Society, Ltd.; J. Platts, architect, Old Bank Buildings, High Street, Rotherham. Three shops and houses in Doncaster Gate; J. Platts, architect, as above.

ROYTON (Lancs.).—Public Baths, for the U.D.C. E. Woodhouse, architect, 88, Mosley Street, Manchester.

RUNCORN.—Eight houses, Stanley Street, for R. Yearsley.

RUGBY.—Three houses, Benn Street, for A. J. Shillitoe; alterations to business premises, High Street, for S. Over.

ST. HELENS.—Houses, Pocket Nook Street and Atlas Street, for Varley and Co., Ltd., ironfounders; Chancery Lane, for Mary Wilson.

ST. MARGARET'S-AT-CLIFFE (Kent). — Electric mains extended from Dover. Probable total of lights to be installed 1,190.

ST. NEOTS.—New Wesleyan Sunday Schools.

SALISBURY.—Houses and stables, Bishopsdown, for A. Edwards.

SCUNTHORPE.—New works for Lysaghts, Ltd.

SEVENOAKS.—Cemetery chapel for U.D.C. S. Towlson, surveyor to h U.D.C.

SHEFFIELD.—Alteration and extension of Nether Congregational Church, Norfolk Street (£1,200).

SOUTHEND-ON-SEA.—Detached house at Cricksea Ferry. J. W. Davies, Audrey Lodge, Ditton Court Road, Westcliff-on-Sea.

SOUTH SHIELDS.—New shop, 56, Frederick Street, for Mrs. Freeman; J. E. Stout, architect, King Street, South Shields. New shop and house, corner Westoe Road and Stainton Street, for Mrs. M. Trimble; J. W. Hanson, architect, 79, King Street, South Shields. Two shops, with suites of offices above, corner of Fowler and Keppel Streets, for Alderman J. R. Lawson. J. M. Dingle, architect, 3, Ocean Road, South Shields. Alterations at the Laygate Divisional Police Station, corner of Laygate Lane and Brunswick Street; S. E. Burgess, borough surveyor, Court Buildings, South Shields.

STACKSTEADS (near Bacup).—Alteration and probable enlargement (after fire) of brickworks. H. Heys & Co.

STALYBRIDGE.—Aqueduct mill to be electrically equipped.

STOCKPORT.—Probable rebuilding (after fire) of hat box works, for Dickenson and Sons. Proposed new public library (£10,000 or £12,000); Corporation.

STOCKTON-ON-TEES.—New school in Yarm Road. Town Council.

STOKE-ON-TRENT.—Buildings in connection with the Cottage Homes, Penkhull. A. R. P. Piercy, architect to the Guardians, Union Offices, Stoke-on-Trent.

STOURPORT.—Alterations to 44, High Street and new farm buildings at Lich field House.

STRATFORD-ON-AVON.—Men's infirmary at the workhouse for the B.G. S. C. Warden, clerk, 9, Guild Street, Stratford-on-Avon.

SUNDERLAND.—Six houses, Hastings Street, for J. & T. Parker; H. E. Robinson, architect. Twenty-three houses, Balmoral Terrace; H. T. D. Hedley, architect. Shelter and underground conveniences; J. W. Moncur, borough surveyor. House, Roker Park Road (South), for R. Swan; J. Potts & Son, architect. Houses, Cato Street, Southwick, for J. Hodgson.

SURBITON.—Extension of business premises for M. Griggs & Co., Victoria Road. Mr. Limpuss, builder.

SUTTON.—Shops and residences; Morgan Baines & Clark, agents, Sutton. Extension of premises for Wootten Bros., drapers; W. Salter, builder, Webber Street, Lambeth, S.E.

SWANSEA.—Houses, Upper Longhor, for Andrew Gwyther; Clyndu, for Evan Thomas; Fforestfach, for Thomas Morgan; Longhor, for John Jones; Armine Road, for T. A. Stephens; Gendros, for Dr. Frazer. New patent fuel works; Graigola Merthyr Co., Ltd.

TAUNTON.—New drill hall and extension of Working Men's Club, Rowbarton; Mr. Gillam, architect, Leslie Avenue, Taunton. Additions to King's College; G. C. Strawbridge, architect, Taunton.

TEWKESBURY.—Probable rebuilding, after fire, of engineering works, for T. Walker.

THORNHILL (near Dewsbury).—House, Slaithwaite Road, for G. & T. Hodgson.

THURLSTONE (near Barnsley).—New offices for the Thurlstone U.D.C. E. W. Dyson, architect, 10, Regent Street, Barnsley.

TINSLEY (Sheffield).—Important extensions to premises. Wm. Cooke and Co., Ltd.

TOWIE (Aberdeenshire).—Renovation of U.F. Church. T. G. Archibald, architect, Huntly.

TRAWDEN (Lancs.).—New elementary school (£7,000). Secretary, Education Authority, Trawden.

TREDEGAR.—Forty houses on Mile Field. A. F. Webb, architect, High Street, Blackwood.

TRING.—Six houses, Longfield Road, for E. Wright.

TRURO.—Residence in Carvoza Road; Pill & Son, builders, Truro. Two houses in Avondale Road; C. and J. Harris, builders, Truro.

WALLASEY.—Extension of the refuse destructor for the U.D.C. (£4,720).

WALTHAM ST. LAWRENCE (Twyford, Berks.).—Additions to Red Cottage, for Mrs. Turner; bungalow, Book Lane, for J. Morris; new schools, West End, for the Berks. Education Committee.

WARRINGTON.—Prospective rebuilding of wireworks for Rylands Bros., Ltd.

WATFORD.—Houses, Watford Road, for Mr. Hayward; Claypit Lane, for E. W. Winch. Iron mission church; Swannell & Sly, architects, High Street, Rickmansworth, Herts.

WHITCHURCH.—Two houses in The Avenue; house in the Parade; S. Shall, builder, Whitchurch.

WISHAW.—Conversion of factory in Miller Street into Home for workmen. Clydesdale Buildings Co.

WOOLSTON (Hants.).—Suite of offices for the Australian Emigrants' Department (£5,000). Guy Prendergast, architect, Sholing.

WOOTTON (Derbyshire).—New premises. Mr. Grindley.

WORKSOP.—Houses, Central Avenue, for T. Clark; alterations to premises, Newgate Street, for Grant & Hall.

WREXHAM.—New theatre. T. Price, architect, 77, Lord Street, Liverpool.

YARMOUTH.—Six houses, Suffield Road, Gorleston, for R. Wales; warehouse, 80, George Street, Yarmouth, for R. B. Phillips.

YORK.—House and shop, 16, Bootham, for Mrs. J. Simpson; additions, 12, Clifton Green, for C. H. Ellison; houses, Norfolk Street, for L. Woodcock; Swinerton Avenue, Leeman Road, for Wm. Chapman. Alterations to pumping station, for the North-Eastern Railway; Wm. Bell, architect to the North-Eastern Railway Co., York.

NOTES.

Shock Fatalities.—On Friday evening, September 4th, Mr. Harold Parker, deputy coroner, held an inquest at Preston Police Station on the body of John Edward Johnson, electrical engineer. Mr. Seymour, H.M. Inspector of Factories, watched the proceedings.

Evidence of identification was given by the father, a retired engineer of St. Helens, who said his son was 45 years of age, and had been employed by Messrs. Dick, Kerr & Co. for the last seven years.

Lewis Dallas said that at 4.30 p.m. on Wednesday, Johnson was near witness, assisting at the switchboard, when he exclaimed "Oh!" and remarking that he had had a shock, let go the switch. He took three steps away and collapsed; soon afterwards he became unconscious. Dr. Walmsley was sent for and attended

deceased, but he died in 20 minutes. Replying to the Coroner, witness said there could not have been more than 300 volts on that particular switch, and he could not account for deceased getting the shock. So far as witness knew, deceased was in good health.

Leonard Lucas, tester's assistant, said he heard the deceased exclaim "Oh!" and he fell into the arms of witness. Deceased said he had had a terrible shock, and lapsed into unconsciousness. Witness thought deceased must have got his boots wet, and he could not account for his receiving the shock otherwise, for the ground was dry. In reply to the Inspector, witness said he had had many shocks during the two or three years he had been engaged on the work. He had had a shock of over 300 volts. About 10 seconds before the accident deceased asked witness to switch off, and he did so slowly. Just as witness broke the circuit deceased shouted.

H. Ainsley Cox, chief of the testing department, said the insulation of the switch was all right, for he tested it immediately after the accident. Deceased had been engaged on this work for nearly 12 months. He had been engaged by the firm for some years, and he had worked for them in Calcutta and Tokio, and only a few weeks ago they had put him forward for a station superintendent's position in Calcutta. In answer to the Inspector, witness said the voltage of the switch was between 200 and 300, and the maximum voltage was 500. Would you consider you had had a dangerous shock if you had got 300?—No. Assuming you got the whole 500, is that a dangerous voltage?—I should not consider it dangerous under the circumstances, because he was standing on dry ground, and the handle of the switch was insulated, and it is absolutely impossible except for a very small leakage to get through, also from the position the rheostat was in he would not be able to get more than 250 volts. This rather rapid breaking of current gives rise to a back shot, does it not?—Yes; you get an inductive kick from the machine. That might go through anything?—Not necessarily. It depends on the size of the machine. In this case it could not go to more than 300 volts to ground. The Inspector: You work up to very high voltages sometimes?—Yes. Have you any particular precautions?—Well, we don't touch anything. Have you any rubber gloves?—We use rubber mats and gloves occasionally, but I don't think anyone cares to use gloves. There are too many pin holes in them, as a rule. The Coroner: Still, they were there if the men chose to use them?—Yes. Witness said he had made some experiments to try to discover the exact voltage under the most favourable circumstances, with the floor wet with brine and boots soaked in brine. They did not get over 650 volts, and that was not necessarily fatal.

Dr. Pilkington, police surgeon, said he conducted the post-mortem examination in company with Dr. Walmsley. The body was that of a well-built, muscular man. There were no bruises, burns, or marks of injury, but there was one very remarkable appearance. In all cases of death, especially sudden death, where the body was filled with blood, the blood gravitated to the lowest parts of the body, which became purple and livid, with the exception of those places on which the body had rested, such as the shoulders and buttocks. In the case of deceased, however, the back was very livid, and there was an unusual whiteness on the buttocks and shoulders, where the weight of the body had rested, but those patches were outlined by a band of red. This band looked much as if it had been made by a hot iron, but the skin was not burnt. Having regard to the healthy condition of the organs, the absence of any actual disease, the congested condition of all the organs, and the evidence he had heard, he concluded that death was due to an electric shock. The extreme amount of fat in the body and round the organs would make deceased less able to withstand any sudden shock. None of the organs were in such a condition as would account for death.

The jury agreed that death was due to an electric shock, accidentally received.

An inquest was held at Wallstown (S. Wales) recently on Henry Ash, an electrical switchman employed by the Ferndale Collieries, who it appeared had been repairing a 1,300-volt cable, and in some way received a fatal shock. Mr. Charles Jones, Chief Engineer, stated that it was customary to switch off the current before examining a cable. A verdict of accidental death was returned.

A Paisley Tramway Case.—Sheriff Principal Kennedy has issued judgment in an appeal by Master Fergus, Johnstone, in an action raised by pursuer against the Paisley District Tramways Co. Fergus sued the company for £250 damages for injuries said to have been sustained by him on October 26th last, when he alleged he was assaulted by a conductor by being ejected from one of the company's cars in Paisley. Sheriff Substitute Lyell on March 16th found the pursuer had failed to prove that he was assaulted, and therefore assoilzied the defenders with expenses. The Sheriff Principal has now recalled the Sheriff Substitute's interlocutor, finding that the pursuer, while ascending the stair of the car, was without lawful justification or excuse assaulted by the servants of the defenders and seriously injured, and he found the defenders liable to reparation to the pursuer, and assessed the damages at £75 with expenses.

Automatic Electric Lifts.—Referring to a recent article in these columns on the automatic electric lift, a correspondent points out a very serious disadvantage from which these lifts suffer—apparently the inevitable result of one of the special and indispensable safeguards that very properly attach to the lift. The particular defect is that the cage cannot be moved either up or down unless the doors are closed. This is essential to safety, for it is obviously wrong that it should be possible for a person on the ground floor, for example, to be able to call the cage down while a passenger was getting into it on the fourth floor. It happened a few days ago that our correspondent entered Alderman's House, E.C., just as the lift began its ascent. The occupant got out at the third or fourth floor, and, as probably he wished to descend by the lift after making a call, and did not wish to lose time, he left the doors open, and thus held up the cage until he came back from the office at which he was calling. By this selfish move he prevented the writer and others from calling the cage down. In this way the cage may be held up at any floor simply by not closing the doors. The apparatus may thus be left indefinitely useless or until someone happens to come along at the floor where the cage is resting and free it by closing the doors.

These automatic lifts are, of course, designed for use in small buildings, where the cost of a liftman would be comparatively considerable. The automatic lift is, in fact, a makeshift applicable to small buildings, but quite unsuitable and even unnecessary for large buildings. It is, indeed, but a step better than the old mouse ladder, out of the slow, crawling cages of which a writer humorously described how hordes of timid aunts had to be swept because they feared to step out of a moving cage. The automatic lift is in brief a very strong argument for office buildings of the American type. They need not be of the excessive American height, but they should be of large area per floor, so that the maximum number of offices shall be served by each lift.

Buildings with one lift only are too small. A building should be at least big enough to require the services of, say, four lifts, the space occupied by stairways being minimised. With four lifts properly attended there should be very little waiting at any floor by a would-be user. Most of the lifts in London are much too slow, and there are very few attendants worthy of the name. Users are regarded by the majority of attendants as intruders, and the way in which the attendant puts on his coat preparatory to attending or finishes his conversation with some fellow servant or other person is most annoying. But few buildings in London have a proper service, nor are even the most modern office buildings well designed or arranged. In any New York office building all the elevators are together in a row, or placed in two sides of a 90° corner, convenient and accessible. How many London buildings are there not in which there are two lifts, hard to find, and at quite different parts of the building?

An office building should be large, rectangular, and of plain design, with straight corridors, and rooms easy to find. Generally, the New York office building is a model that could be copied with advantage in London, except, of course, in the feature of excessive height. Such buildings are self-contained units and afford excellent opportunities for electrical working—lighting, pumping from the well which in London may be a feature of economy, lifts and heating being all worked by electric current.

As a last word on electric automatic lifts, it might be pointed out that the doors should close automatically. This would prevent the selfish retention of the cage at any floor as above described.

Natural Gas.—In a note on the combustion of natural gas by E. L. Mason in *Power*, the writer states that when he ceased to use steam in the gas burners, he saved 17 per cent. of the gas. With steam the flame was blue, and there was no smoke. Without steam the flame was yellow, and smoked badly. He then introduced the gas, which was supplied at 8 lb. pressure, at the end of 4-in. pipes with drilled holes. Each pipe was 7 ft. long, and there were several of them. The gas induced an inflow of air, there was mixture in the pipe, and the pipes were 15 in. from the boiler. The flames were now blue with red tips, and no smoke was made unless when firing heavily, when the flames reached the boiler and were chilled and smoke was formed. There was a further economy of 16 per cent. The gas pressure was now reduced to 16 oz. only, and the arrangement now failed to work well, so a new burner with a 6-in. clear opening, surrounded by gas jets so arranged as to give a whirling motion, was tried, and this gave a white flame and perfect combustion. A white flame, the author considers, is best, for it appears to be the flame of minimum satisfactory air supply, and it is a fairly long flame and punishes the boiler less locally than the short blue flame, which is so hot.

A firebrick wall was built across the furnace as an equaliser of temperature and as a baffler. The conclusions are drawn that mixture of the air and gas should be complete before the gases reach the locus of combustion; that air admission by way of the ashpit is a mistake; that gas can be economically burned where the draught is too poor to burn a sufficiency of coal; that steam retards combustion, though it is a help in preventing smoke. Four colours of flames are found when burning natural gas—green, blue, white and yellow, and they have a temperature intensity in the above order. A yellow flame may indicate insufficient air or lack of mixture. White is the colour to be sought for. Blue is too intense for boiler work. Natural gas is composed so largely of CH_4, that the foregoing must not be taken to apply too closely to ordinary producer gases.

Central Ireland Electric Power Bill Proceedings.—The September issue of the *Irish Engineering and Industrial Review* contains a full report of the Parliamentary proceedings in connection with the above Bill, the evidence including much valuable information as to the production of electricity from peat.

Educational Notes.—City of London College.—The next term commences on the 28th inst. Classes are held in electricity, &c., with courses preparing for the University of London examinations.

University Engineering College.—We have received a syllabus of correspondence courses conducted from this college, which include mathematics and chemistry (J. G. Davis), electrical engineering and applied physics (W. R. Harding), and mechanics and mechanical engineering (H. F. P. Purday).

Heriot Watt College, Edinburgh.—The new engineering laboratories will be opened by the Earl of Rosebery on Wednesday next; they are fully equipped with all kinds of heat engines, and special instruction in prime movers is given to advanced students.

University of London, University College.—Session 1908-9. A course of nine post-graduate lectures on "The Scientific Principles of Radiotelegraphy and Radiotelephony," will be given by Prof. J. A. Fleming, M.A., D.Sc., F.R.S., Pender Professor of Electrical Engineering, commencing on Wednesday, October 14th, at 5 p.m.; the introductory lecture will be open free to the public. (Cards of admission must be obtained beforehand.) Those desirous of attending the course should apply to Walter W. Seton, M.A., secretary, University College, Gower Street, London, W.C.

Appointment Vacant.—Isolation Hospital, Gilroes: Engineer to take charge of steam and electric plant (£2 5s. per week). See our advertisement pages.

Institution and Lecture Notes.—Liverpool and District Electrical Association.—On Tuesday, September 15th, an illustrated lantern lecture will be given by Mr. Claude H. Verity Seacombe, on "The Construction of the Parsons Turbine Applied to Marine Propulsion"; and on the following Saturday, the Association will visit the works of the Railway Signal Co., Ltd., Fazackerley.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—On Saturday last, at the Brompton and Kensington Electricity Supply Co.'s works, Mr. A. E. Langley, assistant works engineer, was presented with an illuminated address and a canteen of cutlery subscribed for by the staff and employés, on the occasion of his marriage. Mr. Henry W. Bowden, manager and chief engineer, made the presentation.

The salary of Mr. C. D. Greenhalgh, assistant engineer at the Malvern electricity works, has been advanced by the U.D.C. from £84 to £104 per annum.

Mr. Gordon Bryant, electrical engineer to the Yarmouth Corporation, was last week presented by the staff of the electricity works with a suitably inscribed marble clock on the occasion of his marriage. Mr. F. S. Berth, the station superintendent, who made the presentation, spoke of the good relations which always existed between Mr. Bryant and those who worked under him.

On Tuesday last the marriage of Mr. C. Turnbull, M.I.E.E., borough electrical engineer, Tynemouth, to Miss Lily Grey Turner, took place at St. James's Congregational Church, Newcastle-upon-Tyne. Mr. and Mrs. Turnbull left the same day for Scotland.

Tramway Officials.—After a good deal of discussion, the Dundee Town Council has confirmed the Tramway Committee's decision to increase the salary of the manager, Mr. Fisher, by £100 per annum.

Obituary.—The death occurred on September 1st of Mr. Richard Jones, late works manager of the Electric Construction Co., Wolverhampton. He was in his 65th year.

CITY NOTES.

Yorkshire Electric Power Co.

During the half-year ending June 30th, 1908, the directors report that the receipts from the sale of energy and for work done for consumers, &c., amount to £8,698, against £7,293 for the preceding half-year. The profit on the revenue account for the half-year amounts to £1,249, as against a profit of £836 for the preceding half-year. After payment of mortgage interest the net revenue account shows a profit on the half-year of £363, as against a loss of £139 for the half-year ending December 31st, 1907. This increase may be considered satisfactory in view of the general slackness of trade and the high price of coal still prevailing. At June 30th, 1908, agreements had been entered into with consumers for a total of 6,578 kw. (8,817 h.p.), being an increase of 1,030 kw. (1,380 h.p.) during the six months. Most of these agreements have been made during the latter part of the half-year, and the consumers are not yet connected. Amongst the new agreements is one with Electrical Distribution of Yorkshire, Ltd., for a supply of energy for tramway purposes in Ossett and Soothill Nether. New mains in the direction of Barnsley are being installed, and it is expected that a considerable load will be secured adjacent to the route. On July 9th, 1908, an extraordinary meeting of shareholders was held to sanction an issue of £45,000 of second mortgages on the undertaking of the company, for the purpose of providing the capital necessary to extend the company's operations, and £32,055 has been applied for and allotted. The directors have appointed Mr. Arthur Herbert Meysey-Thompson as a director to fill the vacancy caused through the retirement of Sir Richard Mottram.

United Electric Car Co., Ltd.

The report of the directors, to be submitted to the tenth ordinary general meeting of the shareholders, states that after paying debenture interest amounting to £2,500, and charging £5,677 6s. 5d. for depreciation, the profit for the year is £7,091 11s. 5d., to which is added £5,095 10s. 3d. brought from last year, making a total of £12,187 1s. 8d.; after deducting preference dividend for the six months ending December 31st, 1907, £3,000, an available balance of £9,187 1s. 8d. remains. The directors recommend that this amount be dealt with as follows:—Preference dividend for the half-year ending June 30th, 1908, £3,000, leaving £6,187 1s. 8d. to carry forward to next year. Mr. Ludford C. Docker owing to ill-health resigned his position as a director during the year, and Mr. Henry Mercer Malcolm, of London, was elected in his place.

Ibbotson Bros. & Co., Ltd.

The report of the directors for the year ended June 30th, 1908, to be submitted to the shareholders at the thirty-sixth ordinary annual general meeting, at Sheffield, on the 21st inst., shows that the profit for the year amounts to £19,766 10s. 1d. After deducting the interest on fully-paid shares and debentures, and the interim dividend (at the rate of 5 per cent. per annum paid March 31st) for the half-year ended December 31st last, and bonus, and adding £8,226 18s. 4d. brought forward from last year, there is an available surplus of £17,162 3s. 5d. The directors recommend that a final dividend at the rate of 10 per cent. per annum (free of income-tax) for the halfyear ended June 30th last (making 7½ per cent. for the year), be paid on September 30th next; that £2,000 be added to the reserve fund; and that the balance of £10,492 3s. 5d. be carried forward. The buildings and machinery have been maintained in an efficient condition out of revenue; and the stock-in-trade has been verified by Messrs. John Watson & Sons. The directors retiring by rotation are Messrs. F. J. Talbot and H. C. Richardson, who are eligible for re-election. Messrs. John Watson and Sons are the retiring auditors, and are eligible for re-election.

Dundee, Broughty Ferry and District Tramways Co.

The directors' report for the year ending July 31st states that the profit (including the sum brought forward from last year) amounts to £3,324 11s. 1d. From this there falls to be deducted:—Interim dividend paid on 6 per cent. preference shares on February 1st, 1908, £1,500, leaving a balance of £1,824 11s. 1d. The directors recommend the disposal of this sum as follows:—(1) To pay final dividend on 6 per cent. preference shares, £1,500; and (2) to carry forward to next account, subject to remuneration of managing director, £324 11s. 1d. Before arriving at the above figures there has been set aside by the directors of the statutory company the sum of £1,200 against depreciation. This fund now amounts to £2,500. The earnings of the tramways have risen this year to £12,609 18s. 8d.; whilst the good weather of the present summer has contributed to this result, the bad autumn of last year prevented further expansion. The directors are pleased to report that the regular traffic has been maintained—the winter traffic particularly showing a considerable increase over the traffic of the previous year—and they look forward with confidence to the coming year. Mr. John Smith and Mr. D. W. Wybrants retire from office as directors, but are eligible and offer themselves for re-election. The auditors, Messrs. Chiene & Tait, also retire, and, being eligible, offer themselves for re-election.

Canadian General Electric Co., Ltd.—The directors announce a dividend of 1¾ per cent. on the common stock for the three months to the 30th inst., being at the rate of 7 per cent. per annum.

Aberdeen Suburban Tramways Co.—At the half-yearly meeting of the shareholders, Mr. George J. Walker, Portlethen, presided, and moved the adoption of the report (Electrical Review, p. 349). Mr. John Thompson said he would rather have seen them paying off part of their mortgages, on which they were paying 5 per cent., and decreasing their indebtedness, than paying a dividend of 2 per cent. The motion was adopted.

Mansfield and District Tramways Co.—The report of the company states that the accounts show a surplus, after providing for the dividends on the 6 per cent. preference shares, of £888, which will be carried forward.

Puebla Tramway, Light and Power Co.—The accounts for the half-year ended December 31st show a net profit, after providing for bond interest, &c., of £7,463, from which have been deducted certain preliminary expenses, leaving a surplus of £6,755, which sum the directors propose to carry forward.

South Metropolitan Electric Light and Power Co., Ltd.—The register of debenture stock holders and transfer register will be closed from the 17th to the 30th inst., inclusive, for the preparation of warrants for interest for the half-year ending September 30th, 1908, payable October 1st.

Johnson-Lundell Electric Traction Co., Ltd.—A meeting of this company was held at Cannon Street Hotel yesterday. After waiting till 11.10, while the board was sitting, the representative of the Electrical Review was, with other reporters, refused admission, the statement being made that arrangements had been made for the meeting to be reported.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	Inc.
Aberdeen	Sept. 2	3,275	+ 47	14	21,899	+ 61	14·4	..
Ayr	„ 5	697	+ 19	16	6,736	— 2	8	..
Bath	„ 2	1,608	— 386	35	25,999	— 1,760	13	..
Belfast	„ 4	7,171	— 70	28	83,137	— 902	37	..
Birkenhead	„ 6	2,155	— 78	23	24,924	+ 581	13·52	..
Birmingham Corp.	Aug. 29	12,196	+ 21	22	137,966	+ 5,271	56·46	..
†Blackburn	„ 26	1,060	— 108	21	25,981	+ 1,108	14·13	..
Blackpool Corp.	Sept. 3	3,981	— 339	..	33,471	— 58	11·87	..
„ —Fleetw'd.	„ 5	2,497	— 460	9	13,849	— 1,316	8·25	..
Bolton	„ 6	4,483	— 225	23	54,803	+ 1,022	42	..
Bournemouth	„ 2	4,247	— 604	22	40,194	— 2,502	21·7	..
Bradford	Aug. 29	9,569	— 155	21	105,368	+ 937	54·9	1
Brighton	Sept. 6	2,197	— 163	23	23,303	+ 596	9·5	..
Bristol	„ 4	9,977	— 774	..	..	..	12·21	..
Brit. Elec. Trac. Co.								
Airdrie	Aug. 28	368	+ 8	34	7,166	+ 89	3·65	..
Barnsley	„ 28	460	+ 76	„	6,108	+ 371	..	..
Barrow	„ 28	580	— 37	„	8,564	— 304	5·37	..
Cavehill	„ 28	242	+ 33	„	3,209	+ 289	..	..
Devonport	„ 28	1,091	— 59	„	15,797	+ 58	8·85	..
Gateshead	„ 28	2,019	— 25	„	34,490	+ 165	11·25	..
Gravesend	„ 28	466	— 102	„	7,317	— 1,095	6·5	..
Greenock	„ 28	1,222	— 193	„	18,377	— 4,403	7·25	..
Hartlepool	„ 28	589	— 134	„	8,326	— 1,641	6·72	..
Kidderminster	„ 28	263	— 51	„	3,997	— 204	..	..
Leamington	„ 18	409	+ 18	„	5,832	+ 377	3	..
Merthyr	„ 28	425	— 17	„	7,227	+ 65	2·9	..
Metropolitan	„ 28	11,957	+1,221	„	194,500	+37,376	22	..
Middleton	„ 28	879	+ 7	„	12,673	+ 466	8·5	..
Mid. Joint Com'tee	„ 14	13,371	— 227	„	185,858	— 1,113	..	..
Oldham—Ashton	„ 28	1,296	— 26	„	20,484	— 202	9·13	..
Peterborough	„ 28	280	— 18	„	4,397	+ 35	5·31	..
Potteries	„ 28	3 273	— 207	„	61,892	— 1,051	29	..
Rothesay	„ 28	1,107	+ 167	„	8,203	— 20	2·75	..
Sheerness	„ 26	148	— 19	„	1,985	— 46	..	..
Southport	„ 28	735	— 153	„	9,952	— 586	6·17	..
S. Metropolitan	„ 28	1,741	— 199	„	27,818	+ 449	..	..
Swansea	„ 28	2,083	— 785	„	32,444	+ 1,232	5·5	..
Taunton	„ 28	93	— 10	„	1,424	— 80	..	..
Tynemouth	„ 28	756	— 24	„	8,215	— 513	3·75	..
Weston-s-Mare	„ 26	851	..	„	5,266	+ 69	3	..
‡Worcester	„ 28	642	— 37	„	9,683	— 38	5·75	..
Wrexham	„ 28	231	— 1	„	3,507	+ 6	..	..
Yorks. Wool. Dist.	„ 28	1,912	+ 88	„	31,483	— 1,211	17	..
Miscellaneous	„ 14	572	— 47	„	6,640	— 539	..	..
Burnley	Sept. 5	2,383	— 225	..	..	..	7·5	..
Burton-on-Trent	„ 6	670	— 31	23	6,412	— 530	10	..
†Bury	Aug. 30	1,183	— 10	21⅚	25,677	— 1,882	22·5	..
Cardiff	„ 29	4,454	+ 91	22	49,099	— 466	..	..
Carlisle	Sept. 5	990	— 1	36	6,291	+ 36	..	..
Chatham and Dist.	„ 3	1,722	+ 81	35	27,010	+ 1,751	14·98	2·14
Cork	„ 3	965	— 47	35	16,249	— 500	9·89	..
†Croydon	Aug. 28	1,227	— 357	22	32,185	— 128	11·25	..
†Darlington	„ 29	212	— 15	22	4,411	— 326	..	..
Darwen	Sept. 4	495	— 32	39	5,882	— 41	4·36	..
Dover	Aug. 29	576	— 52	22	5,571	— 162	4 75	..
Dublin	Sept. 4	12,272	—4,177	..	56,184	—16,542	54·26	5·5
Dundee	„ 2	2,460	— 10	15⅚	19,473	+ 1,214	14·5	..
East Ham	„ 5	1,668	— 227	23	20,074	— 1,150	8·48	·68
Exeter	„ 4	711	— 23	23	7,602	— 168	5·5	..
Glasgow	„ 5	32,718	—1,506	16	237,809	— 1,134	89·5	·5
Hastings	„ 3	2,686	— 536	..	..	..	..	..
Huddersfield	„ 5	3,089	— 161	23	37,669	+ 178	28·5	·5
Hull	„ 5	4,726	— 33	23	55,379	+ 16	13	..
Ilkeston	„ 2	300	— 3	22	3,262	+ 45	3·5	..
†Ipswich	Aug. 29	455	— 72	22	9,274	— 225	10·5	..
Kilmarnock	„ 29	289	— 5	15	2,421	— 165	4·25	..
Lan'kshire Trm. Co.	Sept. 3	2 586	— 121	35	45,495	+ 3,666	17	1·18
Lancashire United	„ 2	2,980	+ 107	35	47,331	+ 2,389	39	1
†Leeds	Aug. 29	6,462	+ 10	22	148,571	+ 4,687	96·75	·25
Leicester	Sept. 5	4,276	— 97	..	..	..	..	..
Leith	Aug. 29	1,038	+ 22	15⅞	8,699	+ 49	6	..
Liverpool	„ 29	21,439	— 686	35	372,854	— 7,195	104	..
††L.C.C.	„ 22	35,359	+4,641	17⅞	725,944	+80,785	121¾	..
London United	Sept. 5	13,506	—2,036	..	208,782	+ 2,543	..	..
Lowestoft	„ 5	805	— 28	49	10,049	+ 140	3·5	..
Manchester	„ 5	29,404	—1,114	23	849,581	+11,025	89·5	11
Newcastle	„ 5	7,435	— 320	23	89,351	— 5,797	..	..
Newport	„ 5	1,905	— 68	23	15,788	— 972	14·5	..
Northampton	„ 3	931	— 3	22⅓	11,009	..	5·5	..
†Oldham	Aug. 30	2 164	— 2	22⅚	45,951	+ 711	24·75	..
Pontypridd	Sept. 5	808	+ 290	23	5,845	+ 2,412	5	1·75
Portsmouth	„ 5	4,628	— 465	23	50,232	+ 286	14·5	..
Preston	„ 2	1,523	— 62	..	..	..	..	..
Reading	„ 3	1,803	— 46	22	14,548	+ 344	13·25	..
Rotherham	„ 3	1,232	— 30	22⅔	13,877	+ 102	10	·66
†Salford	Aug. 31	4,429	— 311	22	105,874	+ 637	38·9	..
†Sheffield	„ 30	5,428	— 127	22⅓	127,578	— 571	37	1·25
Southampton	Sept. 2	2,299	— 78	22	25,244	+ 1,565	..	..
Southend-on-Sea	„ 2	1,422	+ 75	23	11,478	+ 330	..	..
†South Shields	Aug. 29	613	— 5	..	12,789	— 216	..	..
†Swindon	„ 26	144	— 44	..	..	..	4·4	..
Tyneside	Sept. 2	856	— 95	9	4,045	— 373	8·87	..
Wallasey	„ 5	1,924	+ 61	22½	21,494	+ 963	8·72	·22
Walthamstow	„ 5	1,236	— 167	23	15,774	+ 974	9	..
West Ham	Aug. 27	4,235	— 299	22	49,585	— 2,843	14·7	..
Wolverhampton	Sept. 2	1,618	— 96	22	19,411	— 368	12·5	..
Baker St.-Waterloo	„ 5	5,635	+1,470	10	28,315	+ 5,540	4·25	1
Cen. London Rly.	„ 5	13,730	+4,909	10	69,747	+21,470	5·77	..
Char. +, Eus. Hamp.	„ 5	6,065	+1,365	10	31,955	+ 6,880	7·75	..
City & S. Lon. Rly.	„ 6	5,944	+ 183	10	29,242	— 1,190	7·3	1·05
Dublin-Lucan Rly.	„ 4	298	— 33	9	1,506	— 69	7	..
G.N. and City Rly.	„ 5	2.493	— 595	10	12,320	— 2,984	3 5	..
G.N., P'dy. & Brmtn.	„ 5	9,205	+2,030	10	46,285	+ 9,585	9·25	·25
L'pool Overh'd Rly.	„ 6	2,781	— 858	10	14,697	— 2,205	6·3	4·3
Mersey Railway	„ 5	3 675	+ 188	10	18,414	+ 927	4¼	..
†Metropolitan Rly.	„ 6	90.465	+1,679	10	155,190	+ 6,630	24·5	..
Met. District Rly.	„ 5	17.254	+3.390	10	87,176	+15,807	24	..
Anglo-Argentine	„ 2	46,095	+14,282	26	601,377	+116,248	42	..
§Auckland	Aug. 14	15,571	+ 5,608	33½	98,150	+14,831	20·92	1·72
Bombay (B.E.T.)	July 30	4,251	+ 912	30	71,134	+13,945	..	..
§Brisbane	Aug.	17,410	+2,185	..	..	..	..	..
†Buenos A. & Belgr'o.	July 1	3.654	+ 507	26	98,675	+ 1,116	..	..
Calcutta	Sept. 5	6,248	— 17	..	..	..	..	..
§Geneva	June	8 804	+ 464	..	..	..	..	..
§Kalgoorlie, W.A.	July	3,674	..	..	26,729	..	20·5	..
Madras	Aug. 31	1.208	— 40	36	19,875	+ 1,589	12·75	..
Montevideo	June	16,519	+2,597	52	160,490	+24,453	..	..
†Perth (W.A.)	Sept. 4	2 435	— 226	36	49,888	— 1,103	25·48	..

* Compared with the corresponding period of 1907. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

Increasing business continues to animate the Stock Exchange markets. One reason is supplied by the Board of Trade returns; those issued on Monday last show no break in the series of heavy declines in nearly all the principal avenues of industry. This factor has, no doubt, much to do with diverting capital, no longer profitably employable in trade, into the stock markets, and the decrease in the demand for financial accommodation in trade has been a powerful influence in the conditions that have made money so cheap as it is.

It is worth noticing that electrical goods are amongst the few items which show an increase in the list of imports. The amount of the advance is £6,361.

Affairs in the Home Railway market tend to go from bad to worse. The latest reason for flatness in this department is Mr. Richard Bell's speech to the railway men, on Sunday, to delegates of the Trades Unions Congress at Nottingham. Following upon this pronouncement came a general shrinkage in prices, some of which had previously been engaged in an attempt to advance a little. Electrical securities are weak with the rest, although a fall in Central Londons occurred before Mr. Bell spoke. Metropolitan Consolidated, however, had been up to 36½, whence it reverted to 35½. Districts slipped back to 11½, after being better. Baker Street and Waterloo 4 per cent. Debenture stock has risen to 93, and Great Northern, Piccadilly and Brompton Debenture is only a point behind. Charing Cross Debenture stock has begun to attract attention, and at 83½ the yield to a buyer is £4 15s. 10d. per cent., with a very fair prospect of a quiet advance in capital value.

The Canadian group of tramway, light, and power companies still monopolises interest amongst such undertakings. Two or three new-comers are hinted as likely to put in an appearance before long, and it would be rather surprising if the big rise in the securities of existing concerns were not made the excuse for launching others.

Mexico Tramway Common stock has been subjected to profit-taking, and the price, at 125, is two points lower, while the 5 per cent. bonds at 92⅝ have fallen 2¼. Rio Trams, however, are good at 69¼, the bonds also being fractionally better at 90¼. Sao Paulo Tramways Common stock lost 3½ at 158; the usual quarterly dividend of 2½ per cent. has been declared.

Mexican Light and Power Common stock went back four points to 69½, but the 5 per cent. bonds have risen 2½ to 93¼. The 7 per cent. Preference stock stands at 113, and the dividend is cumulative. Shawinigan Water Capital stock rose to 83, and Canadian General put on 3 to 107. A quarterly dividend of 1¾ per cent. is announced on the latter. Business in the company's 7 per cent. Preference stock has been marked at 115.

Better prices are being given for River Plate Electricity shares. The Ordinary have hardened to 21s. 6d., and the Preference to a sovereign, while the 5 per cent. Debenture stock at par displays no change. The shares of the Shanghai Construction Company have recently been admitted to official quotation in the Stock Exchange List, and are called 9¾ middle for the £10 fully-paid shares.

Electricity supply shares are no more active than usual. Having recorded which, there is little further to say. A holder of Metropolitan Ordinary tried to exchange his shares for Preference, the result being that the former fell 5s., and the latter went up half-a-crown. Newcastle-on-Tyne regained their small loss of last week.

Traction issues, except the North and South American, are very quiet, the prices keeping steady. British Columbia Preferred and Deferred each gained 3, and Vancouver Debentures are ½ up. British Electric Traction Ordinary are ½ lower, and Cape Electrics show 1/16 fall, notwithstanding the rush for most things with a South African flavour. London United Debenture came on offer, and was sold as low as 75.

Telegraph varieties have been somewhat neglected, but telephone stocks and shares are firmer in several cases. Anglo-American Telephone and Telegraph rose to 134, which is an advance of the odd 34 points since last autumn. The 4 per cent. Bonds are 1½ better. National Telephone Preferred has again advanced, at the expense of the Deferred. Reuter's shares recovered their decline, and Commercial Cable Fours remain in the ascendant with another rise, of 1½ this time. Western Telegraphs have fallen 7s. 6d.

Manufacturing issues are mainly strong. Dick, Kerr Ordinary and Preference advanced, and Electric Constructions have been quite a feature, with a 5s. rise. Callender's Debenture put on a point.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations Sept. 1st.	Closing Quotations Sept. 8th.	Business done week ended Sept. 8th, 1908. Highest.	Lowest.	Rise + or Fall −	Present Yield per cent.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	1½ — 2½	2 — 3	..	..	..	Nil.
143,300	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	5 %	5 %	5 %	90 — 93	90 — 93	..	..	..	5 7 6
$131,551,400	American Telephone & Telegraph, Cap. Stock	$100	7¼%	7¼%	8 %	8 %	128 —132	133 —137	135½	133	+5	5 16 10
53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	90½— 92½	92 — 94	93	..	+ ½	4 5 1
598,180	Anglo-American Telegraph	Stock	32%	32%	32%	32%	58 — 61	58 — 61	60	59	..	5 14 9
3,200,910	Do. do. do. 6 % Pref.	Stock	5½%	6 %	6 %	6 %	104 —105	104 —105	104⅞	104½	..	5 14 3
3,200,910	Do. do. do. Deferred	Stock	Nil	⅜%	1⅜%	1 %	17 — 17½	17 — 17½	17⅛	16 15/16	..	5 14 3
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	8 — 8½	8 — 8½	8 1/16	..	..	4 14 1
2,383,576	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	87 — 90	88½ — 91½	90½	89	+ ½	4 7 5
16,000	Cuba Telegraph	10	5 %	5 %	5 %	6 %	7½ — 8½	7½ — 8½	..	..	..	7 1 2
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	15½ — 16½	15½ — 16½	..	..	..	6 1 3
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8 — 8½	8 — 8½	..	..	..	6 8 1
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 11 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	8 14 10
60,710‡	Direct United States Cable	20	3½%	4½%	4½%	4½%	12½ — 13⅝	13¼ —13⅝	13 7/16	13¼	..	6 4 10
50,900‡	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135½ —138½	135½ —138½	137½	136⅝	..	5 8 4
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	84½ — 86½	84½ — 86½	86	85	..	4 0 11
1,896,706	Do. 4 % Mort. Deb. Stock. Red.	Stock	4 %	4 %	4 %	4 %	102½ —104½	103 —105	104½	103½	+ ½	3 16 2
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜ — 12½	12⅜ — 12½	12 3/16	12⅛	..	5 5 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	100⅜ —102½	101 —103	101½	100⅜	+ ⅛	3 17 8
269,700	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99½ —101½	99½ —101½	..	..	..	3 18 10
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
181,127	Globe Telegraph and Trust	10	5⅜%	5⅜%	5⅜%	5⅜%	10½ — 11	10½ — 11	10⅞	10⅜	..	5 14 10
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅝ — 14	13⅝ — 14	13⅝	13 9/16	..	4 5 9
150,000	Great Northern Telegraph, of Copenhagen	10	24 %	24%	20 %	20 %	27½ — 29½	27½ — 29½	29	..	..	6 13 4
19,600‡	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	56 — 59	56 — 59	..	..	..	6 7 1
$41,380,400	Mackay Companies Common	$100	1 %	2 %	3½%	4 %	69 — 73	69 — 73	..	..	..	5 9 7
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	69 — 73	69 — 73	..	..	..	5 9 7
384,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜ — ½	⅜ — ½	9/-	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	5 6 8
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	31/32 — 1 1/32	31/32 — 1 1/32	..	..	..	5 8 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	108⅝ -110⅝	109⅛	108½	+ ½	5 8 7
8,725,000	Do. do. Def. Stock	100	5 %	5 %	5 %	6 %	118½ —120½	118 —120	118⅝	118	— ½	5 0 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10½ — 11½	10½ — 11½	..	..	..	5 4 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	5 %	5 %	10½ — 11½	10½ — 11½	10⅜	..	..	4 6 11
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5 1/16	5⅛	..	4 6 11
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	3½%	98½ —100½	98½ —100½	99	98½	..	3 7 8
1,716,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	103 —105	103 —105	..	..	..	3 16 2
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6½%	7 %	7 %	8 %	1 1/32 — 1 1/16	1 1/32 — 1 1/16	..	..	..	5 19 8
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..	4 11 5
99,100	Do. do. do. 4 % Red. Deb. Stock	100	..	4 %	4 %	4 %	88 — 92	89 — 92	..	..	..	4 7 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
11,839‡	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7⅛ — 8⅛	7 13/16	..	..	5 0 0
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
8,083	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	128 —131	128 —131	..	..	..	4 11 7
100,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅜ — 7⅜	6⅜ — 7⅜	..	..	..	5 12 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	4½ — 4⅝	4½ — 4⅝	..	..	..	5 5 3
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2½	Nil	Nil	2½%	2½%	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	4 8 11
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	7 %	13⅜ — 14½	13⅜ — 13⅝	13⅝	13⅜	— ⅛	5 0 11
800,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101½ —103½	101½ —103½	..	..	..	3 17 4
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
84,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	6 %	8 — 8½	8 — 8½	8½	..	..	7 1 2
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	£2 6	9½ — 9¾	8½ — 9¼	..	..	..	2 9 0
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

220,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	8 %	8 %	8 %	9 %	8 11/16 — 8 13/16	8 11/16 — 8 13/16	8 13/16	..	..	5 0 8
260,007	Do. 6 % Cum. Prefs., 1 to 260,007	5	5⅛%	5⅛%	5⅛%	5⅜%	6 3/16 — 6 7/16	6 3/16 — 6 7/16	6 7/16	6 5/16	..	4 9 4
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	141 —146	142 —147	..	..	+1	4 1 8
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock	100	5 %	5 %	5 %	5 %	103 —106	103 —106	..	..	..	4 14 4
880,000	Babcock & Wilcox, 1 to 880,000	1	20 %	20 %	20 %	90 %	3⅛ — 4 1/16	3⅛ — 4	79/4½	77/8	— 1/16	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 13 10
40,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	2⅜ — 3⅛	2⅜ — 2⅝	56/3	..	— ⅛	12 8 6
40,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	3⅞ — 4⅛	3⅞ — 4⅛	..	..	— ⅛	8 9 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	6 6 4
20,000	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3¾ — 4⅛	3¾ — 4⅛	..	..	..	4 14 1
288,200	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	106 —110	106 —110	..	..	..	4 10 11
800,000	Do. do. 5½ % Loch Leven Debs.	100	..	..	5½%	5½%	97 —100	97 —100	..	..	..	5 10 0
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	8 %	129 —133	132 —136	..	..	+3	5 17 6
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	109 —113	112 —116	..	..	+9	4 6 2
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	104 —108	104 —108	..	..	..	4 12 7
223,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	101 —104	101 —104	103½	..	..	4 6 7
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100½ —103½	103	101½	+ ½	4 7 0
188,801	British Electric Traction	10	6 %	3 %	Nil	Nil	1½ — 1⅝	1½ — 1⅝	22/6	..	— ⅛	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	3 %	3½ — 4⅛	3½ — 4⅛	82/6	78/9	..	7 1 2
1,473,653	Do. do. 5 % Perp. Deb. Stock	Stock	5 %	5 %	5 %	5 %	96 — 99	96 — 99	99⅜	97½	..	5 1 0
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	76 — 78	76 — 78	..	..	..	5 15 5
100,000	British Insulated and Helsby Cables	5	8 %	8 %	10 %	10 %	6¾ — 7	6¾ — 7	6 11/16	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6 — 6¼	6 — 6¼	..	..	..	4 12 4
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	91 — 96 xd	91 — 96 xd	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	5/16 — 9/16	⅛ — ⅜	..	..	— 1/16	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	43 — 48	43 — 48	..	..	..	8 6 8
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	7/16 — 11/16	7/16 — 11/16	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	2½%	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	68 — 73	68 — 73	..	..	..	6 3 3
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	50 — 54	50 — 54	..	..	..	8 6
187,610	Calcutta Trams, 1 to 187,610	5	8 %	8 %	8 %	6 %	5½ — 6	5½ — 6	..	..	..	5 0 0
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,930	5	..	5 %	5 %	5 %	4⅜ — 5½	4⅜ — 5½	..	..	..	4 15 3
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
35,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	15 %	9⅜ — 10⅜	9⅜ — 10⅜	..	..	..	6 19 6
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	5 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107 —109	107⅜ —109⅜	..	..	+ ⅜	4 2 2
491,228	Cape E Trams., 1 to 491,228	1	5 %	Nil	Nil	Nil	3/16 — 5/16	3/16 — 5/16	..	..	— 1/16	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	12 %	1 5/16 — 1 11/16	1 5/16 — 1 11/16	33/1½	32/-	..	7 14 10
215,045	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	103 —107	105 —107	..	..	+1	4 4 1
1,898,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	3 %	68 — 70	68 — 70	..	..	..	4 6 11
553,136	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	84 — 86	86½	84	—1	4 12 0
553,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	50 — 53	49 — 52	51	..	..	3 15 6
1,480,000	City and South London Railway	Stock	2½%	1½%	2½%	2½%	32 — 33	32 — 33	33	32½	..	6 8 9

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Sept. 1st.	Closing Quotations Sept. 8th.	Business done week ended Sept. 8th, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1904.	1905.	1906.	1907.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	8	2½%	2½%	5 %	5 %	1 5/16 — 1 9/16	1 5/16 — 1 9/16	..	..	..	9 10 6
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	90 — 93	90 — 93	92	90½	..	5 5 11
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1 3/16 — 1 7/16	1½ — 1½	..	..	+ 1/16	6 13 4
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	6 %	6 %	6 %	6 %	1 — 1½	1 7/16 — 1 9/16	..	..	+ 1/16	4 11 5
282,580	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	99 —103	100 —103	..	..	+1	4 7 5
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	6%	11½ — 12½	11½ — 12½	..	..	..	5 4 0
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	4½%	4½%	4½%	1½ — 2¼	1½ — 2¼	..	..	..	16 12 6
17,139	Do. "A" shares, 01—017,139	5	2½%	4½%	4½%	4½%	1½ — 2¼	1½ — 2¼	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	76 — 79	76 — 79	..	..	..	5 1 3
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	85 — 87	85 — 87	..	..	..	5 14 11
112,100	Electric Construction, 1 to 112,100	9	4 %	Nil	Nil	Nil	3/8 — 5/8	3/8 — 7/8	16/3	13/9	+ ¼	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	9	7 %	7 %	7 %	7 %	1½ — 1¾	1½ — 1¾	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7½ — 8	7½ — 8	..	..	..	6 5 0
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	86 — 90	86 — 90	..	..	..	4 8 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	4 %	¾ — 1	¾ — 1	..	..	..	5 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10¾	10½ — 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	15%	10½ — 11½ xd	10½ — 11½	11	..	..	8 18 10
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5¾	5 — 5¾	..	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 — 109	107 — 109	..	..	..	4 2 7
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	5 %	10%	10 %	10 %	15½ — 16½	15½ — 16½	16½	..	..	6 1 8
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	Nil	Nil	¾%	1 5/16 — 1½	1¼ — 1½	..	..	..	4 0 0
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5¾ — 6	5 7/8 — 6	..	..	..	8 6 8
600,070	London United Trams. (1901), 1 to 50,007	10	6 %	3 %	3 %	3 %	6¾ — 6¾	6¾ — 6¾	..	..	..	4 8 11
399,930	Do. do. 50,008 to 100,000	10	6 %	3 %	3 %	3 %	6¾ — 6¾	6¾ — 6¾	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	5¾ — 6¼	5¾ — 6¼	..	..	..	7 13 10
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	76 — 81	75 — 80	75	..	—1	5 0 0
5,782,062	Metropolitan Consolidated	100	3 %	2¾%	1 %	¾%	35 — 36	35 — 36	36½	35	..	1 7 5
2,640,914	Do. Surplus Lands	..	2¾%	2¾%	2¾%	2¾%	65 — 67	65 — 67	67	65	..	4 2 1
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	11 — 12	11 — 12	11⅞	11½	..	Nil
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/32 — 5/32	3/32 — 5/32	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	7/16 — 7/16	3/8 — 7/16	15/6	..	— 1/16	6 13 4
350,000	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	93⅝	..	..	4 14 9
245,500	Potteries E. Trc.	1	5 %	4 %	4 %	4 %	1/32 — 3/32	1/32 — 3/32	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/32 — 3/32	1/32 — 3/32	..	..	— 1/32	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	17½%	32 — 34	32 — 34	..	..	..	5 14 9
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100½—102½	100½—102½	100⅝	..	..	3 18 1
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	5 %	5 %	5 %	5 %	38 — 42	38 — 42	..	..	..	11 18 2
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	1	Nil	Nil	Nil	10 %	¾ — 1½	¾ — 1½	15/-	..	..	8 0 0
66,666	Do. 6 % C.P., 80,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	6 %	2⅜ — 3	2⅜ — 3	56/3	..	..	10 0 0
46,404	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 76	72 — 76	75	..	..	5 5 3

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5½%	5½%	5½%	5½%	4½ — 5	4½ — 5	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
30,131	Brompton & Kens. Elec. Lt. Sup., 1 to 20,000	5	10 %	10 %	10%	10 %	6¾ — 7¾	6¾ — 7¾	..	..	..	6 9 0
9,869	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6¾ — 7¾	6¾ — 7¾	..	..	..	4 13 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 — 102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	6 %	5 %	5 %	3½ — 4	3½ — 4	77/6	..	..	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3½ — 4	3½ — 4	70/-	..	..	5 12 6
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	94½ — 96½	96 — 99	95⅝	..	+2½	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	4½%	3 — 3½	3 — 3½	..	..	..	6 8 7
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9½ — 10½	9½ — 10½	..	..	..	5 17 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11½ — 12½	11½ — 12½	..	..	..	4 14 1
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 0 0
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
40,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	2 %	2½ — 3	2½ — 3	..	..	..	3 6 8
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	3½ — 4½	3½ — 4½	..	..	..	5 17 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7½ — 8½	7½ — 8½	..	..	..	5 17 8
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 10¾	10½ — 10¾	..	..	..	5 10 4
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	Nil	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	3 %	Nil	¾ — 1	¾ — 1	..	..	..	Nil
433,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	59 — 66	59 — 66	..	..	..	6 16 4
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 5½	4⅜ — 5½	..	..	..	5 4 9
10.000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 — 100	..	..	..	4 10 11
15,000	Hove, 1 to 18,000	5	8½%	9 %	9 %	8½%	6 — 6¼	6 — 6¼	..	..	..	6 10 9
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	10 %	7¾ — 8¼	7¾ — 8¼	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
10,000	London Electric Supply Corporation, Limited, Ord.	3	3 %	4 %	4 %	2½%	⅞ — 1⅛	⅞ — 1⅛	..	..	..	5 8 1
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 4½	4⅜ — 4½	..	..	..	6 3 1
74,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4½%	4½%	89 — 92	89 — 92	..	..	..	4 17 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	6½%	4½ — 5	4½ — 4¾	91/10½	87/6	— 1/16	6 16 10
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 4½	4½ — 5	..	..	+ 1/8	4 12 4
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —109	105 —109	..	..	..	4 2 7
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	84 — 89	84 — 89	..	..	..	3 18 8
260,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	5 — 5⅛	5⅛ — 5⅜	5⅜	..	+ 1/16	7 2 3
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5 7/16	..	4 6 11
10,852	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11½ — 12½	11½ — 12½	..	..	..	5 17 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	— 1/2	5 14 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 99	95 — 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	12½%	10 %	10 %	7 — 8	7 — 8	..	..	..	6 5 0
20,000	Do. do. 7 % Pref. 20,021 to 40,020	5	7 %	7 %	7 %	7 %	6¾ — 7¼	6¾ — 7¼	..	..	..	4 16 7
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	86 — 90	86 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	68 — 72	68 — 72	..	..	..	5 11 1
65,000	South London Electricity Supply, Ord.	5	4 %	4 %	3 %	4 %	23 — 27	23 — 27	..	..	..	6 19 2
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..	4 0 0
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 3/16 — 1 5/16 xd	1 3/16 — 1 5/16	..	..	..	5 12 0
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	102	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	¾ — 1	¾ — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	10 10 6
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	82 — 85	82 — 85	..	..	..	5 5 11
110,000	Westminster Electric Supply, Ord.	5	14 %	12 %	12 %	10 %	7⅛ — 8⅛	7⅛ — 8⅛	7 15/16	..	..	5 17 8
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1906)	5	5 %	5 %	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	5½	..	4 0 0

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. § Interim Dividend.

Bank rate of Discount 2½ per cent. May 28th, 1908.

TRADE STATISTICS OF THE STRAITS SETTLEMENTS, 1907.

The following statement showing the imports of electrical and other materials into the various Straits Settlement ports in 1907 is taken from the recently issued trade statistics; the figures for 1906 are given for purposes of comparison, and notes of any increases or decreases have been added:—

Imports into Singapore.

	1906. Dollars.	1907. Dollars.	Increase or decrease. Dollars.
Gas and Electric Lighting Materials.—			
From Germany	1,125	3,225	+ 2,100
„ Holland	4,190	50	— 4,140
„ United Kingdom...	155,869	179,479	+ 23,610
„ United States ...	6,766	24,119	+ 17,353
„ Other countries ...	4,365	41,159	+ 36,794
Total	172,315	248,032	+ 75,717
Telegraph and Telephone Materials.—			
From Belgium	56,315	18,325	— 37,990
„ Germany	34,045	51,941	+ 17,896
„ United Kingdom...	234,082	104,852	— 129,230
„ Other countries ...	11,571	8,414	— 3,157
Total	336,013	183,532	— 152,481
Tramway and Railway Materials.—			
From Belgium	31,963	67,123	+ 35,160
„ Germany	1,745	6,560	+ 4,815
„ United Kingdom...	118,643	144,086	+ 25,443
„ Other countries ...	31,776	29,156	— 2,620
Total	184,127	246,925	+ 62,798
Machinery.—			
From Belgium	39,007	16,340	— 22,667
„ France	14,220	30,579	+ 16,359
„ Germany	76,666	72,177	— 4,489
„ Holland	52,719	36,434	— 16,285
„ United Kingdom...	688,205	1,084,563	+ 396,358
„ United States ...	161,332	102,536	— 58,796
„ Other countries ...	64,977	111,628	+ 46,651
Total	1,097,126	1,454,257	+ 357,131
Lamps and Lampware.—			
From Belgium	28,615	18,689	— 9,926
„ Germany	203,100	248,142	+ 45,042
„ Holland	2,855	560	— 2,295
„ United Kingdom...	90,512	112,537	+ 22,025
„ United States ...	21,866	25,841	+ 3,975
„ Other countries ...	43,686	53,991	+ 10,305
Total	390,634	459,760	+ 69,126

Imports into Penang.

Gas and Electric Lighting Materials.—			
From Germany	79,426	39,228	— 40,198
„ United Kingdom...	102,920	45,691	— 57,229
„ United States ...	1,250	650	— 600
„ Other countries ...	4,028	11,789	+ 7,761
Total	187,624	97,358	— 90,266
Telegraph and Telephone Materials.—			
From United Kingdom ...	780	1,090	+ 310
„ Other countries ...	3,705	330	— 3,375
Total	4,485	1,420	— 3,065
Machinery.—			
From Belgium	14,865	12,980	— 1,885
„ Germany	35,593	36,608	+ 1,015
„ United Kingdom...	332,278	444,219	+ 111,941
„ Singapore	22,951	37,647	+ 14,696
„ United States ...	25,335	12,290	— 13,045
„ Other countries ...	24,140	11,175	— 12,965
Total	455,162	554,919	+ 99,757
Lamps and Lampware.—			
From Austria	3,390	4,000	+ 610
„ Belgium	3,700	3,560	— 140
„ Germany	45,787	43,422	— 2,365
„ Singapore	6,472	2,943	— 3,529
„ United Kingdom...	56,491	32,593	— 23,898
„ Other countries ...	9,283	6,855	— 2,428
Total	125,123	93,373	— 31,750
Railway and Tramway Materials.—			
From Belgium	—	5,505	+ 5,505
„ United Kingdom...	700	4,070	+ 3,370
„ Other countries ...	600	—	— 600
Total	1,300	9,575	+ 8,275

Imports into Malacca.

Gas and Electric Lighting Materials.—			
From Singapore	256	655	+ 399
„ Other countries ...	—	—	—
Total	256	655	+ 399
Telegraph and Telephone Materials.—			
From Singapore	619	396	— 223
„ United Kingdom...	119	136	+ 17
„ Other countries ...	50	—	— 50
Total	788	532	— 256
Tramway and Railway Materials.—			
From Singapore	1,237	—	— 1,237
„ United Kingdom...	12,045	—	— 12,045
„ United States ...	—	—	—
„ Other countries ...	2,895	—	— 2,895
Total	16,177	—	— 16,177
Machinery.—			
From Singapore	17,785	8,787	— 8,998
„ United Kingdom...	862	4,680	+ 3,818
„ Other countries ...	595	564	— 31
Total	19,242	14,031	— 5,211
Lamps and Lampware.—			
From Singapore	6,240	6,284	+ 44
„ Other countries ...	249	709	+ 460
Total	6,489	6,993	+ 504

N.B.—The average demand sterling rates of exchange were 2s. 4d. in both 1906 and 1907.

ACCOUNTS OF THE LONDON ELECTRIC TUBE RAILWAYS.

The following tables of comparison, giving a complete analysis of the published accounts for the past half-year of the six electric tube railways operating in London, will be of interest to all connected with the working of tube railways.

Table I shows the enormous amount it costs to construct a "tube" railway, more especially the most recent ones.

The aggregate cost of these six tube railways, with their 40·8 double or 81·6 single miles of railway, is £27,575,173, the average cost per double mile working out at £651,352.

This average is considerably exceeded in the case of the four most recently constructed tubes, viz., the Great Northern and City, Baker Street and Waterloo, Great Northern, Piccadilly and Brompton, and the Charing Cross, Euston and Hampstead Railways, which are all tubes of a greater diameter than the City and South London and Central London Railways, as will be seen from the table.

Some idea of the enormous cost of constructing these tubes in the Metropolis, as compared with the cost of constructing surface railways, will be gathered from the fact that while the whole of the railways of Ireland, with their 3,363 miles, cost approximately 44½ millions sterling, these 81½ miles of tube railways in London cost over 27½ millions sterling.

Coming back to Table I, the capital expenditure given includes in all cases the amount expended on rolling stock, the cost of which is given separately by the City and South London Railway only. It is a matter for regret that these figures cannot be shown separately by each of the other companies as well.

In the case of the Baker Street and Waterloo, Great Northern, Piccadilly and Brompton, and the Charing Cross, Euston and Hampstead Railways, the capital expenditure

does not include the cost of a power house, as in the case of the other companies' figures.

In arriving at the capital value of the rent charges for leased lines, the half-yearly rents have been capitalised at 4 per cent. per annum, and the amount of capital still due to contractors has been taken from the accounts.

In Table II—Revenue Account—an attempt has been made to arrive as near as possible at a true comparison. To make an exactly true comparison is impossible, owing to the manner in which the accounts are made out, each of the companies having its own particular method of making up its accounts. For instance, the City and South London

Comparison of the Accounts of the London Electric Tube Railways for the Half-Year Ended June 30th, 1908.

Table I.—Capital Account.

Description.	City and South London.	Central London.	Great Northern and City.	Baker Street and Waterloo.	Great Northern Piccadilly and Brompton.	Charing Cross Euston and Hampstead.
Total Capital Expenditure at June 30th, 1908	£3,135,303	£4,044,469	£2,310,762	£3,122,720	£6,768,442	£5,622,177
Add Capital value (approximately) of Rent, &c., Charges for Leased Lines	13,750	—	506,611	136,025	651,914	143,650
Add Capital remaining to be expended for works constructed	—	—	85,000	87,650	300,200	646,500
Total	£3,149,053	£4,044,469	£2,902,373	£3,346,395	£7,720,556	£6,412,327
Miles of double tunnel and line constructed and leased	8·1	6·9	3·5	4·7	9·5	8·1
Cost per mile (double)	£388,772	£586,140	£829,949	£711,999	£812,690	£791,645
Diameter of tunnels	10 ft. 6 in.	11 ft. 8 in.	16 ft.	*12 ft. 1 in.	*12 ft. 1 in.	*12 ft. 1 in.
Cost per foot (double)	£7·01	£9·74	£9·82	£11·16	£12·74	£12·41

* Mean diameter.

Table II.—Revenue Account.

Description.	City and South London.	Central London.	Great Northern and City.	Baker Street and Waterloo.	Great Northern Piccadilly and Brompton.	Charing Cross Euston and Hampstead.
Receipts:—						
Passengers	£83,475	£163,661	£43,556	£79,869	£142,111	£84,648
Sundries, including Rents of Property	5,026	9,727	2,921	4,499	6,573	4,323
Total receipts	£88,501	£173,388	£46,477	£84,368	£148,684	£88,971
Expenditure.—Maintenance of Way, &c.:—						
Salaries, &c....	£70	£566	£45	£79	£175	£143
Permanent way	1,028	2,477	489	886	1,586	1,264
Signals, &c.	450	654	196	586	825	974
Stations and buildings	459	336	179	595	811	725
Total	£2,007	£4,033	£909	£2,146	£3,397	£3,106
Cost of maintenance per track-mile worked	£70·4	£179·5	£69·9	£94·3	£83·5	£7·80
Repairs and Renewals of Rolling Stock and Lifts:—						
Salaries, &c....	£50	£117	£38	£76	£151	£104
Rolling stock	1,880*	3,967	667	3,611	4,904	2,917
Lifts	— †	1,623	132	566	954	691
Total	£1,930	£5,707	£837	£4,253	£6,009	£3,612
Number of cars	170	238	76	110	225	158
Cost per car...	—	£16·9	£9·0	£33·5	£22·5	£19·1
Number of lifts	39·5	52	14·5	35	62	47
Cost per lift...	—	£32·3	10·4	16·2	£15·4	12·6
Transport Expenses:—						
Salaries, wages, &c.	£10,376	£17,363	5,224	£8,451	£14,336	£11,104
Fuel, lighting, water, &c....	1,849	4,135	1,191	2,917	4,596	3,890
Car cleaning	—‡	1,149	291	1,097	2,049	1,603
Clothing	290	500	170	132	227	128
Printing, stationery and tickets	582	1,975	350	1,111	1,660	1,115
Miscellaneous	—	595	584	143	203	526
Lift working	5,037§	5,269	1,022	4,053	6,525	4,990
Electrical energy	13,934	24,937	8,328	13,723	24,442	19,025
Total	£32,068	£55,923	£17,160	£31,627	£54,038	£42,281
Cost of working per lift	—	£101·3	£70·5	£144·4	£105·2	£106 2
,, per passenger	—	·674d.	·599d.	·587d.	·743d.	·836d.
,, per train mile...	—	1s. 7·734d.	11·996d.	1s. 2·530d.	1s. 1·553d.	1s. 1·113d.
,, per car mile	—	3·274d.	4·018d.	4·288d.	3·465d.	3·908d.
Per cent. of passenger receipts	—	34·17%	39·40%	39·60%	38·03%	49·95%
General charges	£3,168	£7,272	£2,100	£2,032	£2,248	£1,536
Ventilation expenses	Nil	191	Nil	418	838	489
Law charges	34	415	47	231	209	221
Compensation	Nil	351	91	211	544	339
Government duty	99	349	Nil	218	172	64
Rates and taxes	3,199	15,620	2,143	4,317	7,528	4,845
Total Expenditure	£42,505	£89,861	£23,287	£45,459	£74,983	£56,493

* Includes car cleaning.
‡ Included in repairs and renewals of rolling stock.
† Included in lift working under transport expenses.
§ Includes lift repairs and renewals.

TABLE III.—NET REVENUE ACCOUNT.

Description.	City and South London.	Central London.	Great Northern and City.	Baker Street and Waterloo.	Great Northern Piccadilly and Brompton.	Charing Cross Euston and Hampstead.
Balance from Revenue Account ...	£45,996	£83,527	£23,190	£38,915	£73,701	£32,478
Add Net Revenue receipts:—						
Balance from December, 1907 ...	1,120	10,218	380	Nil	14	Nil
Sundries ...	Nil	314	Nil	2,303	135	68
Total Net Revenue ...	£47,116	£94,059	£23,570	£41,218	£73,850	£32,546
Net Revenue Charges:—						
Debenture Interest ...	£13,210	£18,023	£10,084	£13,710	£23,156	£15,910
Rent, &c., Charges ...	275	Nil	8,046	2,721	15,114	2,873
Sundries ...	672*	1,911	4,520*	1,753	6,004	12,930
Total Net Revenue Charges ...	£14,157	£19,934	£22,650	£18,184	£44,274	£31,713
Balance available to meet dividends on Preference and Ordinary stocks for half-year ...	£32,959	£74,125	£920	£23,034	£29,576	£833

* Exclusive of renewal fund contributions.

TABLE IV.—STATISTICS.

	(7·3 miles)					
Average gross receipts per mile worked ...	£12,123	£25,129	£13,279	£17,951	£15,651	£10,984
,, expenses ,, ,, ...	£5,823	£13,023	£6,653	£9,671	£7,893	£6,974
Net receipts ,, ,, ...	£6,300	£12,106	£6,626	£8,280	£7,758	£4,010
Train-miles run ...	694,392	680,126	343,414	522,406	956,933	773,874
Average gross receipts per train-mile ...	2/6·58d.	5/1·18d.	2/8·48d.	3/2·76d.	3/1·29d.	2/3·59d.
,, expenses ,, ,, ...	1/2·69d.	2/7·71d.	1/4·27d.	1/8·88d.	1/6·81d.	1/5·52d.
Net receipts ,, ,, ...	1/3·89d.	2/5·47d.	1/4·21d.	1/5·88d.	1/6·48d.	10·07d.
Car-miles run ...	*3,130,000	*4,100,000	1,024,906	1,770,126	3,142,507	2,596,526
Average gross receipts per car-mile ...	6·68d.	10·15d.	10·88d.	11·44d.	9·54d.	8·22d.
,, expenses ,, ,, ...	3·26d.	5·26d.	5·45d.	6·16d.	4·81d.	5·22d.
Net receipts ,, ,, ...	3·42d.	4·89d.	5·43d.	5·28d.	4·73d.	3·00d.
Number of passengers ...	*11,550,000	19,901,750	6,875,602	12,940,801	17,446,477	12,132,639
Value per passenger ...	1·735d.	1·973d.	1·520d.	1·481d.	1·959d.	1·674d.
Cost ,, ,, ...	·883d.	1·083d.	·813d.	·843d.	1·031d.	1·117d.
Net receipts per passenger ...	·852d.	·860d.	·707d.	·638d.	·828d.	·557d.
Per cent. of expenses (less rates and taxes) to gross receipts ...	44·41	42·82	45·49	48·74	45·37	58·05
Per cent. of total expenses to gross receipts ...	48·03	51·83	50·10	54·42	50·75	63·56
Average number of passengers carried daily ...	63,500	109,400	37,800	71,000	96,000	66,600
,, ,, trains run daily ...	471	542	539	611	553	525
,, ,, passengers per train ...	135	202	70	116	173	127
,, ,, ,, per train-mile ...	17	29	20	25	18	16
,, ,, cars per train ...	4·5	6·0	3·0	3·4	3·9	3·4
,, ,, ,, run daily ...	2,120	3,152	1,617	2,077	2,157	1,785
,, ,, passengers per car ...	30	35	23	34	45	37
,, ,, ,, per car-mile ...	3·7	4·9	6·7	7·3	4·7	4·7
Number of stations ...	15	14	6	11	22	16
Average distance between stations ... (yards)	860·5	867·4	1,026·6	752·0	760·0	891·0

* Approximately.

Co. does not show how much it expends on the repairs and renewals of its lifts or on the cleaning of its carriages, these amounts being included under the heading of "working of lifts" and "repairs and renewals of carriages" respectively. Each of the other companies gives these costs separately. The effect of this is that no comparison can be made of these costs with those of the City and South London Co.

There are other points of dissimilarity in the accounts of the respective companies, for which there does not seem to be any necessity, and some attempt ought to be made by the various companies, through their accountants, to arrive at uniformity in these accounts.

A difference will be noted between the total revenue expenditure shown in the table under the City and South London and the amount shown in the published accounts. This difference is due to the inclusion in the table, under the proper heads, of the amount charged to renewal fund for the half-year.

The City and South London Railway, on account of the smallness of its "tube," continues to be the cheapest worked of all the tube railways; the total working expenses, in ratio to gross receipts, being at the rate of 48·03 per cent.

The next cheapest worked is the Great Northern and City Railway, at 50·10 per cent. This figure is decidedly low, considering the smallness of this company's receipts. Next in order come the Great Northern, Piccadilly and Brompton with 50·75 per cent., the Central London with 51·83 per cent., the Baker Street and Waterloo with 54·42 per cent., and, last, the Charing Cross, Euston and Hampstead with 63·56 per cent.

Energy.—The cost of generating energy for train running during the past half-year for each of the companies works out as follows:—

Company.	Cost.	Per cent. of gross receipts.	Pence per train mile.
City and South London ...	£13,934	15·74	4·816d.
Central London	£24,937	14·38	8·800d.
Great Northern and City ...	£8,328	17·92	5·820d.
Baker Street and Waterloo ...	£13,723	16·27	6·305d.
Great Northern, Piccadilly and Brompton	£24,442	16·44	6·235d.
Charing Cross, Euston and Hampstead	£19,025	21·38	5·900d.

In considering the above figures, the first three companies must be compared together, these companies having their own power houses, whereas the last three companies have no power house of their own, energy being purchased from the London Underground Co.'s power house at Chelsea.

Rates and Taxes.—Rates and taxes are a particularly heavy item of tube expenditure, more especially in the case of the Central London Railway, where for the past half-year the amount expended under this heading was no less than £15,620, equal to 9·01 per cent. of the gross receipts, or £2,264 per mile of railway. None of the other railways approach anything like this amount, their figures being as follows:—

Company.	Amount.	Per cent. of gross receipts.	Per railway mile.
City and South London Railway ...	£3,199	3·62	£395
Central London Railway	15,620	9·01	2,264
Great Northern and City Railway ...	2,143	4·61	612
Baker Street and Waterloo	4,317*	5·68	919
Great Northern, Piccadilly and Brompton Railway	7,526*	5·38	792
Charing Cross, Euston and Hampstead Railway	4,845*	5·51	588

* Exclusive of power house.

Table III (Net Revenue Account), and Table IV (Statistics), need no special comment; they speak for themselves.

REVIEWS.

Practical Mathematics. By F. C. Clarke, B.Sc. London: Edward Arnold. Price 3s. 6d.

In our younger days we had the suspicion that mathematics was nothing more than a bundle of tricks; the author of this treatise seems to indicate that our youthful surmise was not quite groundless.

In the preface to the volume under review the author remarks that his aim is "to emphasise mathematical principles rather than to form a collection of mathematical tricks, and to give methods to be employed in approaching practical problems." The manner in which he has endeavoured to achieve his purpose is thoroughly sound. He does not go into long and laboured proofs of some of the principles which he enunciates, and for the end in view there is no reason why he should do so; it is not so much the knowledge necessary to prove a mathematical theorem that is required in practical work, as the ability to apply it to a practical problem.

The book is evidently meant to cover the requirements of "technical students in evening classes who take a second or third year's course in practical mathematics, and is suitable for candidates for the Board of Education's examinations in Practical Mathematics, Stages II and III." This it should do very well, as it seems to treat all the necessary subjects, but it is essential that the various typographical and other errors be corrected at an early date.

Beginning at Surds and Indices, going through Logarithms (giving a page or two to the Slide Rule), Series, including the Binomial Theorem, Trigonometrical Ratios and Applications and Equations, Mensuration of Regular and Irregular Figures, Graphical Representation of Functions, we reach Rate in Chapter XVI. This is followed by Differential Coefficients in the succeeding chapter, and the Integral Calculus and its applications are dealt with in the next two. Chapter XXI treats of the Position of a Point in space, Centroids and Moment of Inertia, and a table of Radii of Gyration of some simple geometric bodies is given. The two remaining chapters deal with Vectors and Elementary Analysis of Curves respectively.

Most of these points are stated clearly and without that redundancy of expression so often found in text-books of this nature, but somehow we cannot help feeling that the author got tired towards the end of the book and began to curtail the matter. Of course, we may be wrong, but it is at least certain that he might with advantage have gone into the subject matter of the last few chapters more fully than he has done. Vectors, for example, are disposed of in eight pages and the Analysis of Curves in seven.

There is, however, a more serious and objectionable feature in the large number of errors and omissions which are apparent all through the book, both in matter and in formulæ. In a mathematical text-book more than in any other, strict accuracy in this respect is absolutely essential, and the author should issue an *errata* slip at once if he have not yet done so. A few examples occurring in the earlier pages must suffice:—

p. 13, $a = b^y$ should be $a = b^{\frac{y}{x}}$; p. 14, $\log_a N = \frac{\log_b N}{\log_b b}$ should read $\log_a N = \frac{\log_b N}{\log_b a}$; p. 19, line 9, reads "*instruction* of cube roots," while *extraction* is meant; p. 39, $(x + a)^2 = x^3 = 3x^2a + 3xa^2 + a^3$; this expression should, of course, be $(x + a)^3 = x^3 + 3x^2a + 3xa^2 + a^3$; p. 46, the formula for the velocity of sound in a gas is expressed as $v_0 = \frac{v_t}{1 + \frac{1}{2}at^2}$ instead of $v_0 = \frac{v_t}{1 + \frac{1}{2}at}$; p. 51, $\frac{D}{(x - c)^3}$ should be $\frac{D}{x - c}$. That is a fairly long list for the first 50 pages, and there are others less important which we have not mentioned.

On page 195 we meet a very curious statement, which reads thus, "the motion of a piston, if the *piston rod* is long compared with its travel, is approximately simple harmonic." [The italics are ours.] No doubt the author is referring to the action of the connecting rod, but as it stands the statement is very misleading.

We are sorry that a book which promises well should have so many blemishes which careful proof reading could easily have prevented.—J. D. M.

The Law and Commercial Usage of Patents, Designs and Trade Marks. By Kenneth R. Swan, B.A. (Oxon), of the Inner Temple, Barrister-at-Law. London: Archibald Constable & Co., Ltd. Price 6s. net.

The law relating to letters patent is at present in such a nebulous condition that we welcome anything in the nature of a popular exposition on the subject. In the work now before us, the author's aim has been, according to the preface, "not only to present the existing law accurately, but also to present it in such a form as to be readily comprehensible to the layman unfamiliar with legal phraseology, and of value to those engaged in the trades and industries concerned with the patenting of inventions and the registering of designs and trade marks." Further on in the preface, he states that "He has endeavoured to handle the subject from a commercial as well as a legal point of view, paying regard both to interest of the inventor and registered proprietor on the one hand and of the general public on the other."

A perusal of the author's work fully justifies our saying that he has accomplished the task which he set for himself. It is sometimes said of a forest that "you can't see the wood for the trees." So it is sometimes properly said of a law book that "you can't see the law for the cases." This criticism cannot be applied to Mr. Swan's book; and although the lawyer may find it necessary to consult works which refer to more authorities, the layman and, possibly, the patent agent, will be content to refer to a work which includes all the leading cases.

In examining a new legal text-book, it is always interesting to note the author's treatment of recent changes in the law. Indeed, a reviewer might well confine himself to such an examination; for the new work is usually the offspring of fresh legislation. Mr. Swan's method of dealing with the changes made by the Act of 1906 appears to us to be eminently satisfactory. Instead of setting out long and cumbersome sections, he explains their effect in more popular phrase than the draughtsman of an Act of Parliament can dare to use; and in the course of a very few pages he explains the all-important question of compulsory licences. One expression of his opinion upon this important subject is deserving of special notice. After pointing out that those who seek compulsory licences must show that the reasonable requirements of the public have not been satisfied, he says:—"The petitioner has still a heavy task before him. To prove that the needs of the public, that is, the consuming public, are not adequately met, seems to open up an almost boundless inquiry. To prove that the patentee's default is prejudicial to some particular section of the manufacturing public, though less indefinite, presents a sufficiently arduous task to deter any but the most pertinacious and public-spirited."

One other useful feature of this part of the work remains to be noticed. With a view to assisting those who are interested in exploiting their inventions abroad, two chapters are annexed to the patent section of the book, touching upon the subject of foreign patents and containing a synopsis

of the patent laws of the United States, Germany and France. These chapters also include information in tabular form as to the term, fees and conditions of working of patents in the more important of the other foreign countries. As the title shows, this work is not confined to patents. It also deals with the law of designs and trade marks—two subjects which are wedded to patent law by Act of Parliament. In that part of the work which relates to designs we note one very useful feature. On page 306 there appears a table showing in parallel columns certain words which have formed the subject of disputed trade marks. As our readers are doubtless aware, a word forming part of a trade mark may be copied in such a way as to be calculated to deceive. Thus the author points out that "Cocoatina" and "Cocaotine" as applied to beverages have been held to resemble each other so closely as to be calculated to deceive; while it has been held that with regard to the words "Ivy" and "Ivory," as applied to soap, there was sufficient dissimilarity to negative the probability of confusion.

A good index to each part of the work completes a text-book which is well calculated to please those for whom it was written.

Electrical Traction. By Ernest Wilson and Francis Lydall. London: Edwin Arnold. Vols. I and II. Price each 15s.

These volumes form the second edition of a book by one of the authors on "Electric Traction" published in 1897. Owing to the rapid strides made in electrical haulage since that date, it has become necessary to rewrite the whole work, thus eliminating matter which, however interesting it may be, can now only be regarded as historical, and at the same time to enlarge the work so as to incorporate the latest phases of the art. The work has appropriately been divided into two volumes—Vol. I covering continuous-current traction, and Vol. II alternating-current traction, both single and three-phase, the former volume being naturally the larger of the two.

In reading the preface, one is somewhat taken aback at the statement that there are comparatively few engineers in a position to make a decision as to which system should be employed. This statement is too sweeping, and needs considerable modification. Engineers who would be consulted on such important matters are thoroughly capable of examining each particular scheme in detail, and would make a recommendation only after giving the matter the most careful consideration. The books, as stated in the introduction, cover only the special apparatus peculiar to electric traction, that is to say, practically nothing is said about the generating plant. This is a pity in more senses than one, as there are quite a number of points where a traction station differs from a lighting station; but, on the other hand, the work has already assumed dimensions sufficient for a somewhat elementary treatise. As the work is also intended for advanced students, who are perhaps not entirely familiar with the subject, greater stress should have been placed on accuracy and clearness—all through the work there is just this want of lucidity.

In certain portions it is made clear that the authors themselves are not familiar with the matters on which they write. Ambiguity also exists in many places—for instance, does the list showing the extent of supply and traction undertakings refer to England, Great Britain, or the British Isles? Again, one of the distinguishing features of a traction motor is stated to be that "it is totally enclosed," yet a page or so later we find that the doors (in the motor) are ventilated in order to provide a free circulation of air around the commutator, &c. In the footnote to the paragraph on the choice of motors, the rating is given as the H.P. output giving 75° C. rise above the room temperature; nothing is stated about this temperature being the temperature by thermometer. Laxity in the phrases used is common; for example, what is the meaning of the "heating current" of a motor? Again, in discussing electric braking we are told that it is necessary to disconnect the supply, reverse the *motors*, &c.; would it not have been better to say—reverse the armature connections? The authors are also wrong in stating that welding is a substitute for bonding; at least the Falk cast-welded and the Thermit welded joints should be bonded. The eccentric cam in the Peacock brake is not fitted to the brake handle, but to the spindle; and the rheostat boxes are not always placed under the car, although generally so; neither is it necessary to insulate the trolley head from the pole in a single-decked car. Why call the well-known Brill 21-E truck the Preston 21-E? The blocks illustrating the Chicago and Columbia bond shows fishplates with four fishbolts, which is liable to give a wrong impression to even advanced students, and the diagram, fig. 71, showing the bonding at a double-track junction, would certainly not be tolerated in England. The chapter on "Overhead Construction" is weak; the authors appear to be under the impression that figure-8 wire is the same as grooved wire, whereas, of course, it is quite different. Fig. 101 is simply a shocking piece of overhead construction; even the anchors are shown pulling the wrong way. Fig. 107, showing a typical section box, is incorrect, as the trolley wires are not put in parallel but kept separate, while fig. 108, which the letterpress describes as providing for both positive and negative feeders, does nothing of the sort. Tables 16 and 17 in the Chapter on "Feeder Systems for Tramways" are somewhat obscure; an explanation might have been given as to how the figures are arrived at. The supplementing of the rails for the return current by means of unboosted cables is hardly a commercial proposition. Fig. 144, showing a return cable with a booster having the fields in series with the armature, is stated to be wrongly connected. This is not so. The reviewer has designed several systems operating with these connections with complete success. Table 19 would give useful information, if the insulating material of the cables were specified. The depreciation on a battery is given at 6 per cent., the same as on a steam unit; 12 per cent. would have been nearer the mark. Why is the heating of a motor on the regenerative system of control any greater than in the ordinary series-parallel control with rheostatic braking? There is not a very clear description of the difference between the yoke and nose methods of suspension, in fact, at times the two are confused. There is an inclination to lay rather too much stress on the possibilities of eliminating the locomotive. The remarks regarding shunting and acceleration are correct as regards local trains, but these qualities do not play an important part in the case of main-line trains. The formula

devised for the non-spring-borne load, viz., $m + M\frac{K^2}{K^2 + Y^2}$ does not appear to be correct as a general solution, for, putting $Y = 0$, the factor $\frac{K^2}{K^2 + Y^2}$ becomes unity, and we have the non-spring-borne load ($m + M$) as in the case of the New York, New Haven and Hartford Railway, whereas the whole of the armature is spring-borne. Mention is made of manganese steel frogs for railway use, and it is stated that they have given good results on the Broad Street Terminal, Philadelphia. The writer has seen similar frogs at Messrs. Hadfield's works, made, he believes, for the North-Eastern and London, Brighton and South Coast Railways, so that credit is also due to this firm. Qualification is needed to the remark that attention to uniformity in the angular velocity of the generating sets will overcome hunting in rotary converters. Experience has proved that, even with turbine-driven generators, hunting is liable to cause trouble unless the drop between the main station and the sub-stations is kept within reasonable limits.

Laxity in expression is still more prevalent in Volume II; thus the statement that, "In a transformer with magnetic leakage there is in addition to the main field which threads both primary and secondary a leakage field *attached* to each of the coils," &c., the expression "attached to" appears hardly correct. Reiteration is very monotonous, and takes up valuable space. A specific case of this occurs in discussing the diagram of the transformer with magnetic leakage, with an additional E.M.F. in the secondary circuit. It is stated —"as before let O A (fig. 4) represent the primary current, and let O E represent the additional E.M.F. in the secondary"—these very words are repeated three lines lower down. Is 4 in. a reasonable clearance between the over-

head construction and the profile of the maximum rolling stock for live high-tension wires? It is very doubtful.

The above faults form only a small portion of those met with in perusing the work. There are many more which might have been obviated by a more careful reading of the proofs. In spite of all its faults, however, the work, more especially Vol. II, will be found to be of considerable interest, and it is in more ways than one the most complete and up-to-date work at the present time dealing with this all-important subject. Vol. II can be especially recommended, as in it are incorporated data which it is difficult to find without searching back files of the technical Press. Both volumes are liberally illustrated with clear blocks and diagrams, and the printing is excellent. Each volume is provided with a very handy and complete index.

Electrical Instruments and Testing. By W. H. Schneider. London: E. & F. N. Spon. Price 4s. 6d. net.

It is almost a pity that the majority of the books which deal with this and kindred subjects hail from America, and, therefore, describe apparatus and methods which are seldom, if ever, seen or used in England, while they make use of a technical terminology which necessitates a certain amount of translation as one reads. However, in the case of the book under review we must admit that but little difficulty is felt on account of the latter objection—we had almost said fault.

Every student of telegraph or telephone engineering must at some time or other have had to make a study of some such work as Kempe's "Handbook of Testing," and to all such we can cordially recommend Mr. Schneider's work as forming something in the nature of an introduction to the more advanced problems and reasoning embodied in the former. In this book the language used throughout is simple and direct (we could wish that every text-book were expressed in terms as simple and direct), and the formulæ which it is necessary to employ are all led up to in a specially clear and concise manner, in such a way as to prepare a student to absorb the principles underlying the application of any formula to parallel cases which might arise in actual practice.

The preliminary chapters give an account of what is practically standard apparatus, and the matter therein is particularly good, as it contains descriptions and details of instruments which, in a good many cases, are only to be found after a more or less exhaustive search through several makers' catalogues.

Chapters V to VII contain descriptions of the various tests and operations carried out by means of the Wheatstone bridge and its various modifications, made up into portable testing sets such as are not frequently seen over here, but as the principles embodied therein are the same whatever the pattern of the testing set, the tests outlined are well worth studying for their application to the sets mostly used in England.

There is a good chapter on the Potentiometer, and some useful data regarding condensers and cables, and towards the end of the book many tests are shown which may be carried out with a voltmeter—tests such as one does not see described generally in text-books, but only in the occasional articles and communications published in the technical Press.

In the Appendix are some chapters devoted specially to the Testing of Telegraph and Telephone Circuits. These are contributed by Mr. Jesse Hargrave, of the Postal Telegraph and Cable Co., but whilst most interesting and valuable from the general information conveyed therein, are scarcely of practical value to the practical English telegraph engineer, whose operations are conducted along the orthodox lines laid down by the Post Office, as that administration controls most of the longer circuits in this country.

We should add that throughout the book the illustrations are attractively good, and the diagrams very well drawn and clear.

Fareham Electric Lighting.—On September 2nd a L.G.B. inquiry was held into the application of the U.D.C. for a loan of £10,000 for electric light purposes. There was no opposition.

THE WEDNESBURY PUZZLE.

A good deal has appeared in the Press, both technical and otherwise, with regard to the situation in Wednesbury. From time to time statements have been made at the Wednesbury Council meetings, and reported in the local Press, from which it would appear that the Midland Electric Corporation for Power Distribution, Ltd. (hereinafter referred to as "the company"), had absolutely and entirely failed, and, moreover, refused to carry out the obligations under its provisional order to lay distributing mains and supply electricity in Wednesbury. It is a long way back to our school-boy days, but we can remember the lad who said "It wasn't me," before he was accused; we also know that the drum which makes the biggest noise does not always give the best music. Perhaps this may account for the apparent apathy of the company in generally ignoring and only occasionally contradicting this and other mis-statements, and continuing the even tenour of its way in supplying electricity in bulk under the terms of the agreement entered into between it and the Wednesbury Corporation.

The time has now arrived when the true situation may be represented:—The company obtained its provisional order in Wednesbury, along with several others, in 1898. Owing to its being the first power supply company in the country, and working under so many provisional orders, an enormous amount of preliminary and pioneer work had to be got through. However, in the following year specifications were issued, and early in 1900 orders placed for building and equipping the generating station at Ocker Hill, Tipton, and five sub-stations. These were established in positions favourable for giving a supply to the whole system, namely, Wednesbury, Tipton, Bilston, Brierley Hill and Old Hill. Along with the others, the Wednesbury sub-station was built and equipped without delay.

A year afterwards (January, 1901) the question of public lighting was raised by the Wednesbury Corporation, which made inquiries as to when the company would be able to give supply. The building of the generating station was then nearing completion, part of the machinery had been delivered and erected, and it was expected that, in three or four months, the station would be properly equipped. The mains for all the districts for which the company held provisional orders were in course of manufacture; the laying, however, had not actually commenced, but the company expected, in a comparatively short time, to be in a position to begin a supply of electricity for all purposes, including the supply of Wednesbury. The Wednesbury Corporation was informed of this.

Immediately following this inquiry was another by the Wednesbury Corporation for a supply to it in bulk for private and public lighting. Negotiations were commenced, and in due time a consulting engineer was appointed by the Wednesbury Corporation, who continued the same.

A suggestion was advanced by the Wednesbury Corporation that it should deal only with the lighting consumers, leaving the power consumers to the company. These proposals naturally led to lengthy negotiations, which eventually terminated in the working agreement under which a bulk supply has since been given.

As stated, the sub-station building in Wednesbury was completed and the electrical equipment for the general supply installed, and it remains to this day as evidence of the company's determination to carry out its obligations. When the negotiations referred to began, the order to lay distributing mains was suspended, and on the execution of the agreement referred to the order was withdrawn, it being arranged that the company should lay no distributing mains whatever in Wednesbury, but that the Wednesbury Corporation should take its supply in bulk from the company, and itself install the necessary distributing mains.

These extremes form the alpha and omega of the whole matter. Obviously many meetings, numerous letters and lengthy negotiations were sandwiched in between. These, however, do not affect the situation. The statements which have been made in the Council Chamber at Wednesbury from time to time, that the company has consistently neglected to lay distributing mains in the town have, therefore, no foundation in fact. Had the question of public

lighting, and the application which immediately followed it, for a supply in bulk, never been raised by the Wednesbury Corporation, the company would have proceeded with the laying of its mains in Wednesbury, and the supply would have been available some six years ago.

The attitude of the Wednesbury Corporation in approaching the Local Government Board for a loan to install gas generating plant is too well known to be more than mentioned. The plant is now in operation, and it will be interesting to the electrical world to watch the success, or otherwise, of a supply derived from gas engine-driven generators assisted by batteries, for general power and lighting.

Everything seems to have been straightened out now. The prices for power and lighting offered by both authorities are almost identical. The generating plant installed by the Wednesbury Corporation consists of two 165-KW. dynamos driven by gas engines assisted by a battery. The generating plant of the company consists of five sets totalling over 6,000 KW.

The result of the competition between the two authorities will be watched with interest. The Wednesbury Corporation is relying, to a great extent, on the loyalty of the ratepayers to support its undertaking, and the company is relying on its reputation and ability to give a continuous, constant, and ample supply of energy for all purposes in Wednesbury, as it has succeeded in doing for years past in the remainder of its area, comprising almost the whole of the Black Country, nearly 70 square miles in extent.

TARIFF ALTERATIONS.

A Reply to Mr. Hoadley.

By HENRY JOSEPH.

The metallic filament has much to answer for. It is setting all the station engineers a-quaking. The A.C. men are already suffering from decreased revenues, and their D.C. brethren are terribly apprehensive lest they should follow suit. Meanwhile, wonderful schemes are devised for catching the unwary consumer who uses the metal filament, and either making him pay more for his unit (without knowing it), or giving him a more or less unlimited use of the supply for a nearly fixed annual sum. Messrs. Handcock & Dykes would make his lights jump, if he tried to use more lamps at a time than he had agreed to pay for: Mr. Long would fix his current bill in proportion to the size of his house; and now Mr. Hoadley would fix his *maximum possible* demand only, and put no limit on his consumption.

The first two with various other suggestions are on the principle of a fixed quarterly charge plus a low price per unit. Mr. Hoadley would limit the demand by means of sealed lamp-holders, but would give an unlimited supply for a fixed yearly charge.

The present writer, a few years back, in order to save the cost of slot meters, tried the experiment of supplying cottages for 6d. per week in the summer months, 9d. per week in the autumn and spring months, and 1s. per week in the winter months. They were fitted with seven 8-C.P. lamps, the sitting-room having two, one of which was arranged, by means of a two-way switch, so that it could not be used at the same time as the passage light. That was the only limit imposed. The houses were wired free and a proportion of the takings set aside as interest on the wiring. The result was disastrous. It was perfectly astonishing how much current they used. It worked out at about 30 units per 8 C.P. per annum, which is three or four times as much as an ordinary consumer uses. Of course it did not pay. It is generally recognised that such small property is best left alone. The income of the tenant does not as a rule permit him to pay enough for his supply, however he is charged, to meet the capital charges on the meters, mains, wiring, services, &c., to say nothing of the generating plant, required to supply him.

Mr. Hoadley would doubtless find that, unless he limited the consumption in some way, his average price per unit was far too low with any class of consumer that he supplied on the lines he suggests. It may be well to supply some specially large consumer on a yearly contract basis; some institution or other that can only be weaned from gas by being convinced that the costs will at least be no greater. The writer has obtained a few consumers in this way; a yearly charge, sometimes inclusive of lamp renewals, being offered, which is based on the kilowatts to be connected, all current being charged at 1d. per unit. Such a system, it is admitted, is not a very sound one, and does not theoretically possess the advantages from the suppliers' point of view of others based on the maximum demand. But in practice it is better, as it does not entail inconvenience to the consumer and is only used in very special cases. But to adopt Mr. Hoadley's plan would, the writer is afraid, give most alarming results if he applied it to existing consumers. They would at once enormously increase their consumption —they would hardly be human if they did not—and they would pay no more to the supply undertaking; they would not be typical men of Kent if they did. Therefore it is not quite clear in what way the undertaking would gain. Would the facilities for unlimited supplies of electricity be sufficient inducement to non-consumers to adopt electric light? No; the tariff would have to be framed so as to reduce the total cost to the existing consumers before the others would flock in. The writer's experience with the small cottages was that the average price obtained was only just over 2d. per unit instead of 7d. (the rate for slots), owing to the extravagant use of the supply, and with the larger consumers more recently connected on the yearly contract system it is about 4d., instead of 6d. So it is quite clear that, if a tariff is to be framed for Maidstone (where the unit is at present 4d.) such that the existing consumers are to have their bills reduced, or even remain the same, such bills including the cost of metallic-filament lamps, the average price to be obtained would be extremely low. Therefore increased costs for generation would be accompanied by a reduced revenue from existing consumers, to be followed, perhaps, by an increase in the number of consumers, also being supplied at a very low rate. This appears to be the fault with all such proposals, and it is accentuated in the plan advocated by Mr. Hoadley. The saving in meters would surely be more than compensated for by increased generation costs. The only argument in favour of Mr. Hoadley's plan is its simplicity. Doubtless it would be popular. But would it pay?

Various plans have been suggested and tried from time to time, with a view to making the consumer pay in proportion to his load factor, but the writer is strongly of opinion that electricity has to be dealt with in the same way as the attractions at a fair—"What we lose on the swings we make up on the roundabouts." After all has been said and done, we shall come back to a flat rate for all purposes, with a sliding scale for large consumers, and possibly a two-rate meter for consumers whose demand for power or other purposes in the daytime is likely to be sufficient to justify the increased meter rental. Such a system may not be sound in theory and it may not be equitable, but it has the merit of simplicity. Station engineers are apt to believe, because they give a great deal of thought to electricity supply tariffs, that the consumer will do the same. The average man is not going to be bothered with a lot of complications. He likes an account that he can understand, and will not put up with all sorts of restrictions to his use of the supply.

Surface Condenser Orders.—The condenser department of Messrs. Willans & Robinson's Rugby Works has, during the past two months, received several important orders for surface condensing plants, including five sets for the Westminster Electric Supply Co. (per Messrs. Kennedy & Jenkin); three sets for Japan; one set for Edmundson's Electricity Corporation; one set for the British Mannesmann Tube Co., South Wales; one set for the Dewsbury Corporation; one set for Western Australia, &c.

German Enterprise in Constantinople.—It is reported from Constantinople that the Allgemeine Electricity Co., of Berlin, is establishing in the Turkish capital an office and machinery store for electrical undertakings of all kinds.

New Works.—It is stated that the Stolz Electrophone Co., of Chicago, have decided to build premises at Coventry, spending £20,000 on works and machinery.

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

17,706. "Adaptable instantaneous carrier for shades for incandescent electric lights and the like." W. A. G. Hill. August 24th.

17,730. "Improvements in alternating electric energy integrating meters." R. Kennedy. August 24th. (Complete.)

17,742. "Improvements in holders of glass, porcelain, and other non-conductors, for metallic filaments of electric incandescent lamps." Lichtwerke G.m.b.H. (Date applied for under Sec. 91 of the Act, April 21st, 1908, being date of application in Germany.) August 24th. (Complete.)

17,748. "Improvements in or relating to automatic electric circuit-breakers." A. J. Boult. (Electrical Manufacturing Co., United States.) August 24th. (Complete.)

17,750. "Improvements in or relating to cylindrical positive electrodes." A. J. Boult. (Allgemeine Akkumulatoren-Fabrik, Germany.) August 24th. (Complete.)

17,752. "Improvements in electric switches." F. Luling. (Date applied for under Sec. 91 of the Act, August 31st, 1907, being date of application in Switzerland.) August 24th. (Complete.)

17,772. "Apparatus to disinfect the telephone speaking tube." J. W. Mackenzie. (Telephon Desinfectoren Gesellschaft, Germany.) August 24th. (Complete.)

17,787. "Improvements in chains for supporting or ornamenting electroliers and the like." H. Collett and E. J. Perry. August 25th.

17,793. "Improvements in or relating to switches for controlling reversing electric motors as applied to electric elevators and the like." J. Whitelaw. August 25th.

17,797. "Improvements in water current motors." J. Nolan. (Date applied for under Rule 18, July 24th, 1908. An invention comprised in Application No. 15,704, dated July 24th, 1908.) August 25th. (Complete.)

17,806. "Improved plunger connection for wiring bayonet joint incandescent electric lamps." E. A. Bresman. August 25th.

17,809. "Magneto-electric igniting device with symmetric polar pieces." T. Bergmann. August 25th. (Complete.)

17,816. "Electric igniter." T. Bergmann. August 25th. (Complete.)

17,822. "Additional improved means of control for petrol electric or electric cars." W. A. Stevens. August 25th.

17,835. "New or improved method of producing high-frequency currents and apparatus." R. Goldschmidt. August 25th. (Complete.)

17,841. "Improvements in keyboard telegraphic transmitters." S. E. Page. (The Telegraph Transmitting Instrument Co., United States.) August 25th. (Complete.)

17,852. "Improvements relating to continuous-current motors." D. Dupont and Harle & Cie. (Date applied for under Sec. 91 of the Act, August 27th, 1907, being date of application in France.) August 25th. (Complete.)

17,886. "Improved electric battery." H. Falk. August 25th. (Complete.)

17,890. "Improvements in and relating to protective devices for electrical installations." British Thomson-Houston Co., Ltd., and E. B. Wedmore. August 25th.

17,912. "Series sparking-plug for internal-combustion engines." O. D. B. Payne. August 26th.

17,934. "Improvements in automatic telephone exchanges." J. A. Palmborg. (Date applied for under Sec. 91 of the Act, September 3rd, 1907, being date of application in Sweden.) August 26th. (Complete.)

17,936. "Improvements relating to novel means for producing electric energy." J. H. Reinecke. August 26th. (Complete.)

18,017. "Improvements in or relating to the regulation of the speed of electric motors." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) August 27th. (Complete.)

18,088. "Improvements in three-wire telephone systems." F. J. Dommerque. August 27th. (Complete.)

18,053. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 27th.

18,054. "Improvements in and relating to incandescent lamps and the manufacture thereof." W. C. Arsem. (Date applied for under Sec. 91 of the Act, September 16th, 1907, being date of application in the United States.) August 27th. (Complete.)

18,082. "Automatic tell-tale for motor car rear lights, railway tail lamps, or lights in mines, sinkings, or any light at a distance or out of ordinary sight." H. Hicken and H. J. Kidston. August 28th.

18,086. "Electro-magnetic arrangement fixed in penny-in-the-slot boxes for starting electric pianos, organs, orchestrons, and the like instruments which are using self rewinding perforated music rolls." A. P. Stone. August 28th. (Complete.)

18,109. "Manufacture of an improved material opaque to electric radiations or the like." W. Gow. August 28th.

18,115. "Improvements in electric cells." J. Spiliotopol. August 28th. (Complete.)

18,135. "New or improved variable speed alternating current motor." R. C. Black. August 29th.

18,159. "New or improved device for joining or coupling the ends of electrical cables or other wires or rods together." H. Houghton. August 29th.

18,165. "Automatic differential circuit-breaker." E. F. Rowley and F. C. R. Maidment. August 29th.

18,172. "Improvements in and relating to apparatus for controlling the lighting and extinguishing of gas, the flow of fluids or the actuation of electric switches, and for analogous uses at predetermined times." H. W. Harris. August 29th. (Complete.)

18,182. "Improvements in telephones." C. Adams-Randall. August 29th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1907.

Cooling or Ventilating Dynamo-Electric Machines. H. G. Reist. 23,710. October 26th. (Date applied for under International Convention, October 26th, 1906.)

Electrical Water Heaters. E. J. Condon. 23,801. October 28th. (Date applied for under International Convention, November 1st, 1906.)

Portable Electrical Vibratory Massage Apparatus. F. Singer. 25,426. November 16th.

Means for Supporting the Trolley Wires or Conductors of Electric Tramways. G. R. Feather. 25,863. November 22nd.

Rotors of Alternating-Current Machines. Siemens Bros. Dynamo Works and J. Birrer. 26,134. November 26th.

Electrical Ignition Apparatus for Internal-Combustion Engines. R. Bosch, trading as the firm of Robert Bosch. 26,435. November 29th. (Date applied for under International Convention, February 7th, 1907.)

Alternating-Current Machine. R. Goldschmidt. 27,260. December 10th.

Electrically Signalling or Communicating Messages or Signals to Vehicles Running on Rails. W. Barnett. 27,891. December 18th.

Operation or Control of Alternating Electric Current Generators and of Motors Supplied Thereby. H. A. Mavor and Mavor & Coulson, Ltd. 9,950. April 29th.

Apparatus for Facilitating and Checking Code Telegraphy. A. Tracey. 15,016. June 29th.

Electric Transmission at a Distance. J. Mladek, W. Mladek and K. Samal. 17,332. July 29th.

Magneto-Electrical Ignition Devices for Internal-Combustion Engines or the like. A. J. Postans. 17,468. July 30th.

Electric Circuit Breakers. British Thomson-Houston Co., E. B. Wedmore and W. P. Hamlyn. 17,475. July 30th. (Application for Patent of Addition to No. 27,358/06.)

Thermo-Electric Generators. W. Fennell and W. P. Perry. 17,490. July 31st.

Marine Electrically-Controlled Steering Gear. B. P. Haigh. 18,444. August 15th.

Rheostatic Electric Controlling Switches. British Thomson-Houston Co. (General Electric Co., United States.) 20,597. September 12th.

Screw Clamp Device for Electrically Connecting Electric Wires and other Conductors, also Applicable for other Purposes. W. Scheffler and W. Schumacher. 24,505. November 5th.

Electric Fuse Holders. Electric and Ordnance Accessories Co. and R. F. Hall. 25,478. November 28th.

Device for Supporting the Trolley Wires or Conductors of Electric Tramways. G. R. Feather. 25,864. November 22nd.

Protective Devices for Electrical Systems and Apparatus or Conductors. British Thomson-Houston Co. (General Electric Co., United States.) 27,222. December 9th.

Jointing System for Preventing the Falling of the Aerial Wires of Electric Tramways. A. G. Boon and F. Mellaerts. 28,494. December 27th.

Electrolytic Current Rectifiers. A. S. Hickley. 17,458. July 30th.

Electrically-Propelled Vehicles, Boats and the like. P. E. Trainor. 17,526. July 31st.

Electric Switch for Series Lighting. H. J. Dowsing. 17,661. August 2nd.

Holders or Supports for Telephone and Telegraph Wires or the like. W. E. Lake. (H. B. Newhall.) 17,683. August 2nd.

Arc Lamps. Deutsche Beck Bogenlampen. 17,718. August 2nd. (Date applied for under International Convention, August 2nd, 1906.)

Manufacture of Filaments for Incandescent Electric Lamps. R. Jahoda, I. von Loti, S von Loti and R. Latzko, trading as Electrische Gluhlampen Fabrik "Watt." 18,153. August 8th.

Method of Manufacturing Filaments for Electric Lamps. O. Imray. (Gluhlampen Fabrik "Union" Ges.) 19,157. August 26th.

Switch and Circuit Breakers for High Potential Circuits. J. N. Kelman. 20,110. September 9th.

Electric Battery also Applicable for the Manufacture of Sulphuric Acid. L. P. Basset. 21,475. September 27th. (Date applied for under International Convention, October 2nd, 1906.)

Automatic Electric Circuit Breakers. A. Eckstein, A. C. Heap and D. B. Mellis. 21,904. October 4th.

Means of Electrically Connecting Dynamo-Electric Machines with their Supply or Distributing Circuits. E. M. Duncan. 22,457. October 11th.

Methods of Producing Electric Oscillations. R. C. Galletti. 27,269. December 10th.

Electric Resistance Thermometers. J. Y. Johnson. (Firm of W. C. Heraeus, (Germany.) 27,569. December 18th.

Electrical Igniters for Internal-Combustion Engines. Felten & Guilleaume Lahmeyerwerke Akt.-Ges. 27,825. December 17th. (Date applied for under International Convention, December 19th, 1906.)

1908.

Electrically-Operated Signals for Railroads. H. T. Jones. 7,586. April 6th. (Date applied for under International Convention, May 13th, 1907.)

Process for the Manufacture of a Material from Peat for Electric and Heat Insulation, Sound-Deadening and other Purposes. H. Branco and G. Gumpert. 8,017. April 10th.

Differential Relays. Felten & Guilleaume Lahmeyerwerke Akt.-Ges. 8,288. April 14th. (Date applied for under International Convention, May 4th, 1907.)

Alternating-Current Motors of the Commutator Type. Allgemeine Elektricitäts Ges. 8,414. April 15th. (Date applied for under International Convention, April 17th, 1907.)

Supporting Hooks for Electric Glow Lamp Filaments. W. Schaffer. 9,479. May 1st. (Date applied for under International Convention, May 3rd, 1907.)

Electric Arc Lamps. H. Baggett. 9,501. May 1st.

Dynamo-Electric Machines. Allgemeine Elektricitäts Ges. 9,577. May 2nd. (Date applied for under International Convention, May 4th, 1907.)

Dynamo-Electric Machines Fitted with Commutation Poles. Siemens Schuckertwerke Ges. 9,637. May 4th. (Date applied for under International Convention, May 16th, 1907.)

Actuating Device for Magneto-Electric Ignition Apparatus. Firm of Unterberg & Helmle. 11,432. May 26th. (Date applied for under International Convention, December 6th, 1907.)

Means for Mounting on Poles Slotted Hollow Arms for Supporting Electric Conductors in the Open. T. Buchhols. 13,837. June 30th. (Date applied for under Rule 18, July 19th, 1907.)

Suspending Devices for Electric Conductors. R. L. Hoffman. 1,239. January 18th. (Date applied for under International Convention, October 8th, 1907.)

Control of Alternating Electric Current Motors of the Commutator Type in their Application to the Driving of Machine Tools and other Similar Drives. British Thomson-Houston Co. (Allgemeine Elektricitäts Ges.) 3,056. February 11th.

Electrical Control of Railway Traffic. W. R. Sykes, W. R. Sykes, jun., and C. J. Cooke. 5,489. March 11th.

Contact Breaker Mechanism for Ignition Apparatus of Explosion Motors. Soc. d'Electricité Nilmelior. 6,162. March 19th. (Date applied for under International Convention, November 9th, 1907.)

Electric Ventilator. M. Levy and M. Mehlhose. 8,874. April 23rd.

Electric Cable Boxes or Troughs. Siemens Schuckertwerke Ges. 899. January 14th. (Date applied for under International Convention, September 16th, 1907.)

Sparking Plugs. A. Schanschieff. 1,705. January 24th.

Electric Motor Control. E. F. W. Alexanderson. 1,773. January 25th. (Date applied for under International Convention, January 26th, 1907.)

Electrical Ignition Devices for Internal-Combustion Engines. Firm of R. Bosch. 4,257. February 25th. (Date applied for under International Convention, November 6th, 1907.) (Application for Patent of Addition to No. 4,137/1908.)

Electrodes for Arc Lamps. Allgemeine Elektricitäts Ges. 4,762. March 2nd. (Date applied for under International Convention, March 1st, 1907.)